MASSIVE CONSTRUCTION ON THE MAMMOTH POWER DAM

Progress of Work in the Illinois Division of the Mississippi River Power Company Project---Recent Views of Completed Arches and of the Spillway Section.

The big task of building is progressing so rapidly that an observer can almost see the Keokuk and Hamilton dam grow. Rapid progress is being made in the construction work on the Illinois shore. On this page is presented three large views, two of them heretofore unpublished, showing the present status of construction there. These illustrations show the "traveler" and steel forms, a nearly completed spillway section and forms partly set for another, and some completed arches of the dam on the Illinois side which were photographed July 25.

The Dam Traveler.

The method adopted for building the dam involves the use of the dam itself from the Illinois abutment out as a means for transporting concrete and all construction materials and tools. The permanent superstructure of the dam is a bridge at hand for this purpose, requiring no additional structure of any kind to receive the tracks. Concrete trains can move out on the dam only as far as its superstructure has been completed. But, in the progress of building, new concrete must be deposited a considerable distance forward from point of delivery by trains. For this purpose a large gantry crane, known as the "dam traveler," has been erected on the Illinois abutment and this crane will move forward as work progresses and always be the connecting link for transporting a bucket of concrete from mixer to final location in the dam. The traveler is a heavy steel structure, consisting of a main frame, the dimensions of which in plan are 25 feet by 90 feet, center to center, and the cantilever extension 25 feet by 150 feet, center to center. The main frame is permanently mounted on six heavy cast steel tracks of 100-pound rails and heavy I-beams permanently bedded in the masonry. The gantry frame is arranged to accommodate three railroad tracks on the bridge, the clearances being 24 feet wide and 16 feet high above track rails. One of the standard derrick cars may pass through under the gantry. The traveler is provided with three over-head trolley runways, 10 feet apart and 210 feet long, each to serve one on the delivery tracks underneath. Each runway is equipped with its trolley tackle and rope carriers, all under control of one man by means of two engines. The engine platform is at rear of traveler at a lower level than trolley runways and the operators stand in positions commanding a clear and unobstructed view of the delivery tracks underneath, and the entire work forward. The apparatus is designed for the highest speed of operation practicable within the limitation of length of runways. Traversing motion of trolley is by means of endless line and spool-drum rig, actuated by a separate reversible engine. Hoisting and lower motion is by a single running block rig, actuated by a more powerful engine. The engines are specially designed for their duty and are operated by compressed air from the central power plant through a large receiver mounted at rear on top of traveler. Each bucket containing one and one-half cubic yards of concrete, with all suspended tackle, weighs four tons—this is the standard load to be handled. The trolley runways are located 24 feet above bridge, and are so rigged that loads may be picked up, moved in either direction or deposited at any point within their length. The forward posts of traveler are 65 feet high, and the entire machine with all equipment on board weighs 175 tons.

The Steel Forms.

Ordinarily wood construction is used for the "forms" in which concrete masonry is deposited and contained until set. The dam contains 119 arch spans, 36 feet long from center to center of intervening piers. The grade line of bridge is 53 feet above average bed rock bottom. The piers are 6 feet thick by 42 feet wide at top, and the bridge is 29 feet wide. Wood forms for this work would be complicated and their cost in time, labor and materials would be prohibitive. Forms made of structural steel are therefore adopted for this work, and those of particular interest for description at this time are for the piers and arches. The forms for each pier contains a main frame of one upstream leg and one downstream leg, with connecting struts between them at the top. The width of these legs equals the net thickness of the pier and they are spaced and located at the bottom by means of cast iron base plates anchored to small concrete piers built on the bed rock. The bottom of each leg has two sockets to receive projecting dowels in the corresponding base plate and it will therefore be evident that no instrument work of any kind is necessary to line up the forms after the base plates have been accurately placed in position. The up and down stream legs are connected together continuously by side members of about five feet high, forming a continuous steel wall on each side of the pier from the bottom up to the springing line of the arches. These side members are securedly bolted to the end legs and to each other, and are stay-bolted through and through in a manner to withstand the bursting pressure of wet concrete. Each pier form as a whole is connected to its neighbor by struts and trusses at the top, and these connections insure the correct spacing of the piers lengthwise of the dam. The arch centers are three hinged arches, so arranged they may be removed after concrete is set without the use of weges, shores or blocking of any kind. All the forms are faced with steel plate in such a manner that the masonry is nowhere in contact with steel shapes or structural details other than the smooth surface of steel plate.

Owing to the large number of motors employed to run the different machines, it was found necessary to centralize the generator. Again the selection of the motive power required one that would be simple, safe and effective. Compressed air has all these attributes and near the end of the dam is situated the central power plant. It consists of the engine and boiler rooms. The engine room contains the air compressor and lighting plant. The air compressor is of the compound two stage type of twenty-five hundred cubic feet free air per minute with an air pressure of 115 pounds per square inch.

The boiler room, directly adjacent, has five boilers of 800 horse power total capacity, which furnish steam to the compressor, dynamo and to the crusher plant. The compressed air is used for running all of the derricks, the shops and stationary engines. It drills, paints, tests the rock, cleans belts, operates valves and pumps water.

All material is brought from the Hamilton railroad yards over the company's own standard gauge tracks. There are on the Illinois shore six standard equipment construction locomotives which move the material from one point on the works to another as required. In order to maintain the equipment in working condition, repair shops are run in connection with the construction plant. These include the machine shop and carpenter shop and in connection with these there is a general warehouse which distributes the material over the works.

The labor employed is foreign and American. Owing to close proximity of the works to the city of Hamilton, no large camp was necessary except for housing of the foreign labor. This is accomplished through two camps maintained by the company. Each bunk house contains sixteen men, each man paying a small rent per month for his bunk and providing his own food. All the bunk houses are electric lighted from the company's plant have running water and are inspected by the company's surgeon.

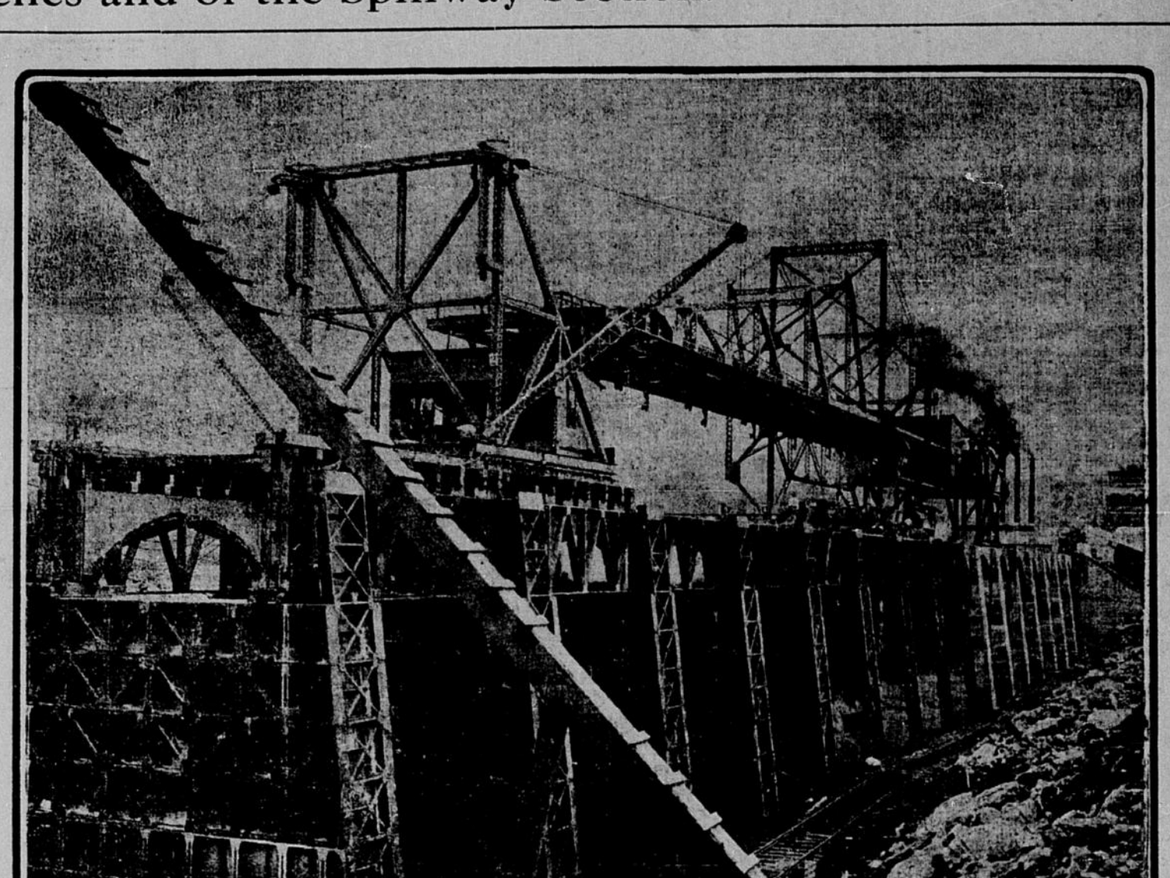
All the clerical and engineering work for the Illinois division is done on the Illinois shore, a separate organization being maintained for the purpose.

In addition to the above and of special importance, a well equipped testing laboratory is maintained on the Illinois shore, which laboratory tests carefully the cement and the actual mortars used in the work. Mortar tests are drawn from the concrete buckets as they are enroute to the traveler that deposits them in the permanent work. In addition to the foregoing the cement is all carefully tested for soundness and strength, as provided by strict specifications, before the cement is loaded at the cement mill for shipment to the works warehouses.

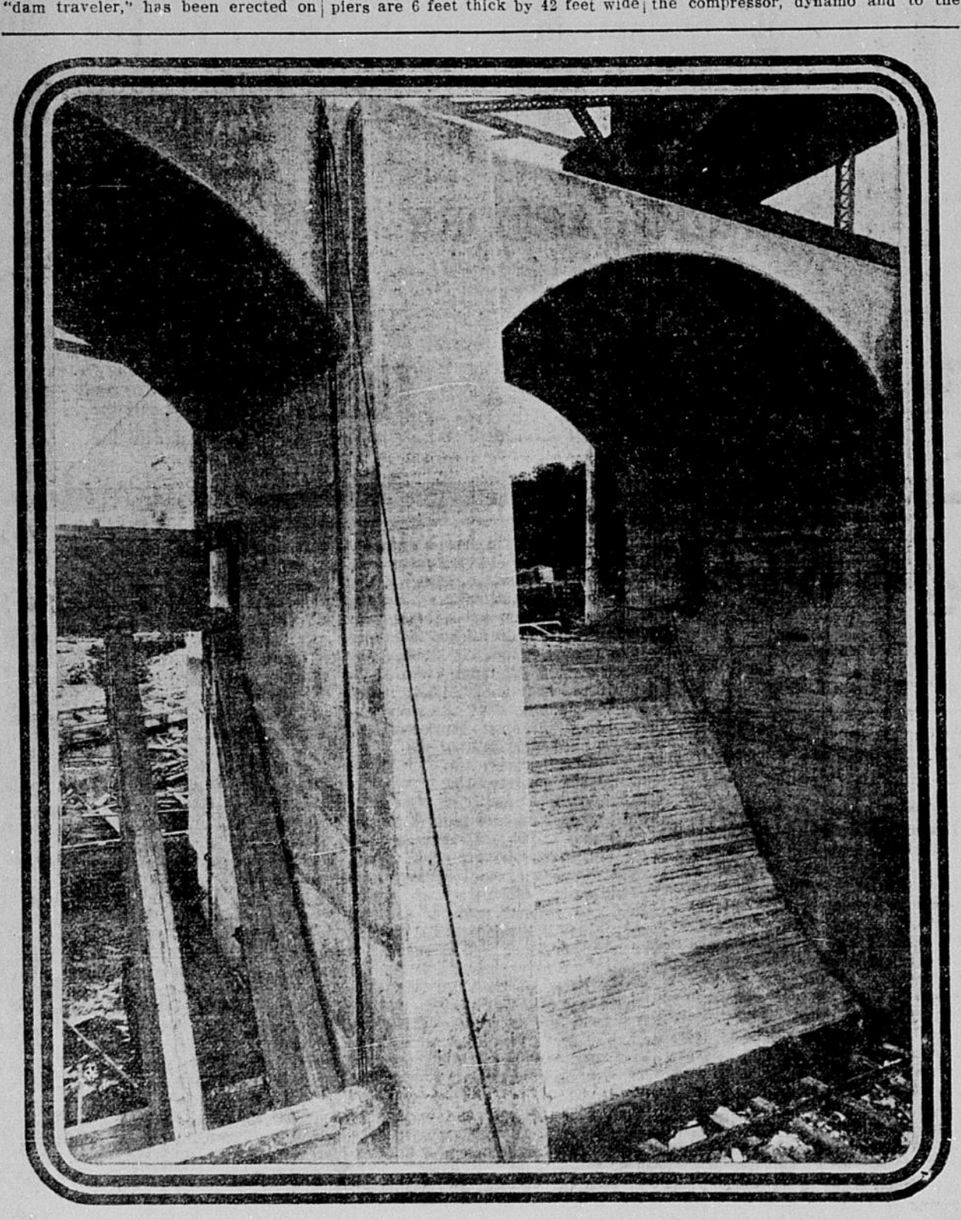
The capacity of the construction plant is twelve hundred cubic yards of concrete per day of ten hours. This involves the moving of one hundred car loads of rock, fifty car loads of sand, six car loads of cement and the moving of one hundred trains of concrete per day, which will be accomplished by the aid of machinery and about two hundred and fifty men.

The amount of concrete to be placed from the Illinois plant is approximately two hundred thousand cubic yards to be extended over seven-eighths of a mile of structure and should one concrete train be consigned to convey all the concrete to the dam it would travel a distance of nineteen thousand miles and should the number of buckets of concrete be placed side by side they would reach from New York to Philadelphia.

It will be noted that on both sides of the river the pick and shovel are largely eliminated. The bulk of the material is handled by machinery.



Illinois division—Some completed arches of the dam, photographed July 25, 1911.



Above illustration shows a nearly completed spillway section and forms partly set for another.

PANAMA CANAL GEOLOGICAL STATE

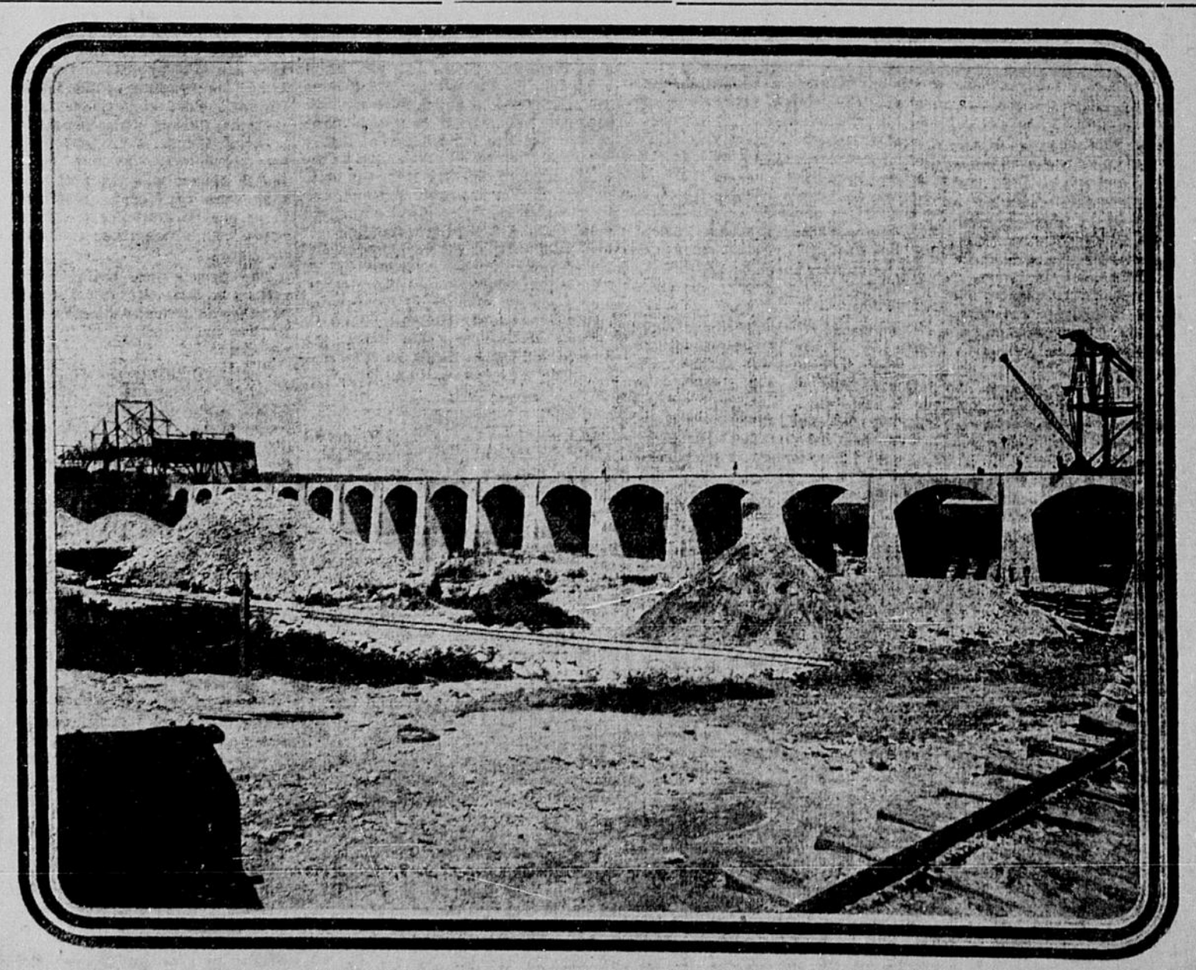
Volcanic Nature of Range of Hills and Worries of Engineering Force.

The volcanic nature of the geological formation of the range of hills through which the great Culbera cut is being excavated is causing our army engineers at the isthmus a great deal of trouble and is adding a considerable sum to the cost of the Panama canal. When the French, under De Lesseps, some 25 years ago commenced to bite their way into the Culebra divide, they were at once confronted with the delay and expense involved in the sliding of the hillside into the excavated cut. The material which moved down was composed mainly of the mass of clay which overlaid the surface of the slopes, and it was the belief of the French, as it was also the belief of our American engineers at a later date, that when cutting had been carried down to the firmer, underlying rock there would be no further trouble from this source.

Unfortunately the rock has proved to be so badly fissured and generally of such an unstable character that it has refused to hold the angle of slope at which the canal is being cut. As the excavation has gone down, huge masses of material, many acres in extent, have started to slide, generally upon some underlying stratum where friction was unequal to the task of holding the superincumbent weight against the pull of gravity. The Culebra cut extends for a distance of about nine miles, and at present over a score of slides are in motion, more than one-half of these being of considerable size. Over one-fourth of the total length of the cut shows evidence of instability, and is either moving or liable to move before the work is done.

The largest of the slides, if we take account of its area, is the one at Cucaracha, which already has a total surface area of about 50 acres. This is the slide which caused the French so much trouble. Since American occupation over 2,000,000 cubic yards have been removed, and there is a possibility that another 2,000,000 cubic yards must be handled before the slope has reached an angle of repose. Near Gold Hill are two other slides, with a total area of about 35 acres, from which 3,000,000 cubic yards have already been taken, and where at least another 2,000,000 cubic yards must be removed.

As the cut is carried down to its final depth, conditions will, of course, be aggravated. Other slides will start, and existing slides will reach farther up the slopes of the hillside. It is impossible to predict to what magnitude the present movements may ultimately attain as the cut is carried down to grade, and there is, of course, some possibility that portions of the cut which are now stable will ultimately give way. By the present methods of excavation and removal by steam shovel and work trains the cost of getting rid of the slides is about 50 cents a cubic yard. Colonel Goethals, in estimating the cost of completing the canal, made a liberal allowance—if we remember rightly, about $16,000,000—for the removal of slides.—Scientific American.



Illinois shore—Progress of dam July 13, 1911. Showing traveler and steel forms.