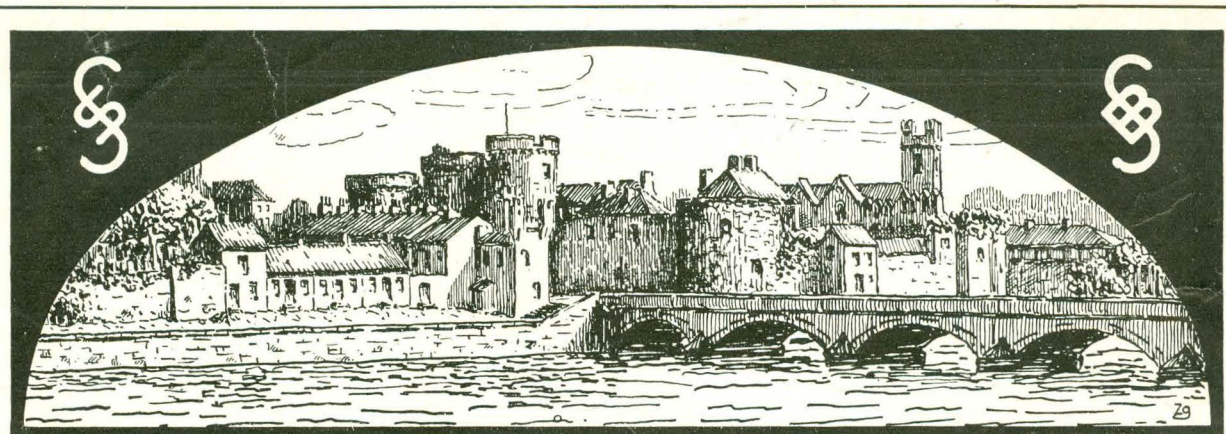




Siemens-Schuckertwerke
Aktien-Gesellschaft

SIEMENS

Siemens-Bauunion GmbH.
Kommandit-Gesellschaft

PROGRESS ON THE SHANNON

2nd YEAR

APRIL 1928

NUMBER 7

Model Experiments on the Design for the Weir near Parteen Villa

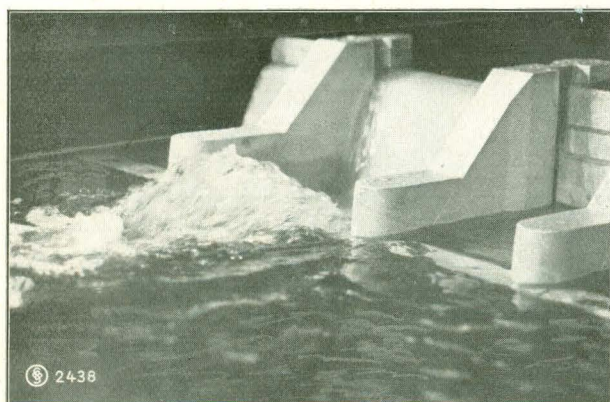
In connection with the design of the Weir at Parteen Villa, the following model experiments were carried out in the Hydraulic Laboratory, Technical High School, Berlin, under the supervision of Professor Doctor-Eng. Ludin. The experiments were carried out under the instructions of the Minister of Industry and Commerce for the Irish Free State on the recommendation of Professor Meyer-Peter and Professor Rohn, advisory Engineers to the River Shannon Power Works.

The object of the experiments was to determine what alterations to the proposed design for the Weir were necessary to improve the discharge and reduce, as far as economically practicable, the erosive effect on the river bed downstream of the Weir.

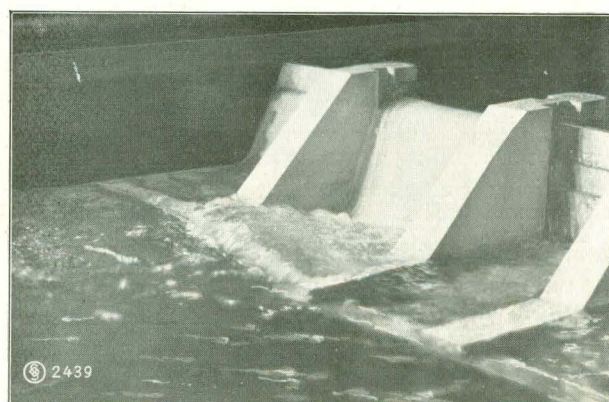
The Weir is situated 9 km. below Lough Derg,

the site selected for foundations being an outcrop of hard red sandstone covered with shingle. After completion of the works, lake conditions will be extended practically up to the Weir; it may be assumed, therefore, that very little silt will be carried to the Weir.

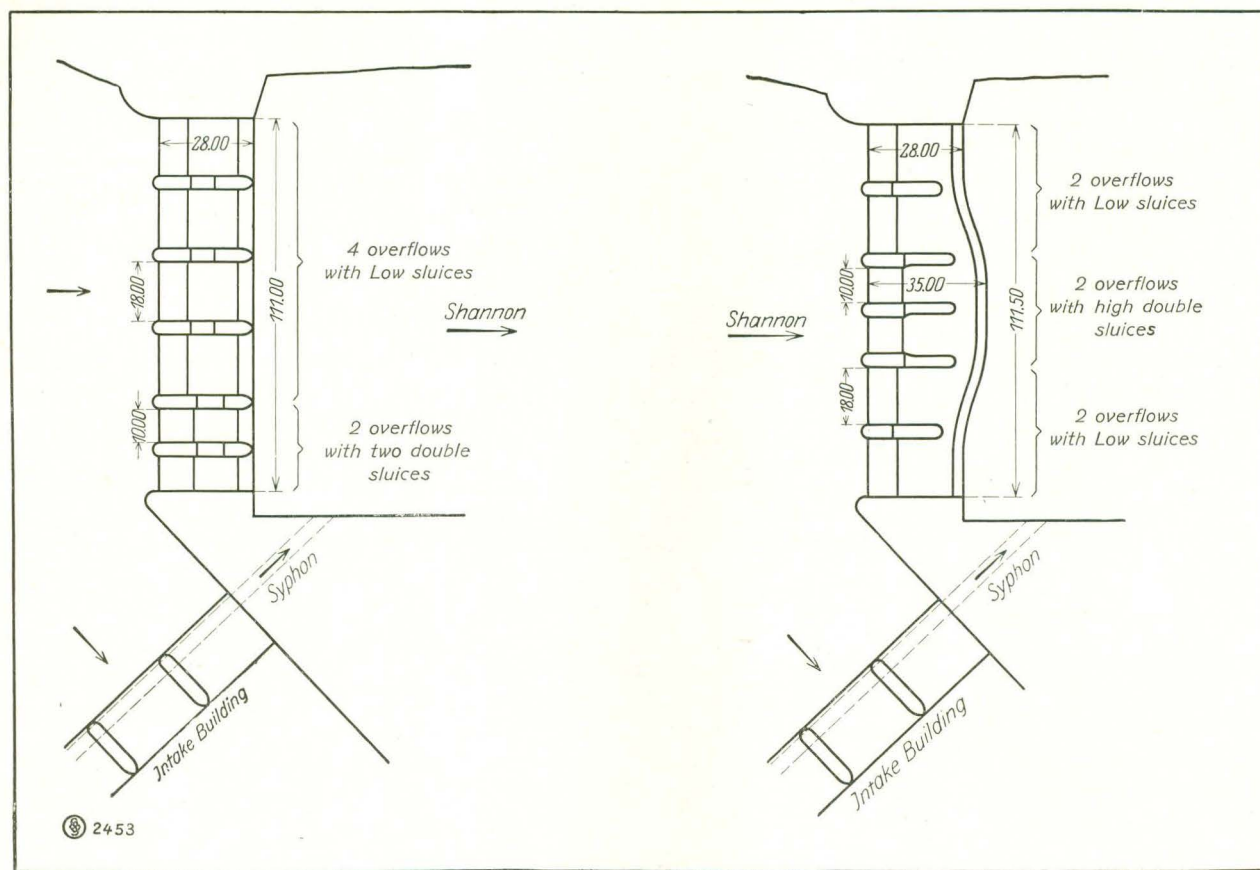
The maximum flood to be discharged through the Weir is taken as 920 cbm/sec., assuming no discharge through the Head Race canal. To provide for this the following Weir openings were taken: four openings each 18.0 m. wide with crests of Weir at level + 33.00 (full development) and two deep sluices each 10 m wide with crest of Weir at level + 24.80. The upstream water level is fixed at + 35.70 and downstream water level estimated at + 28.20 m. The average level of the river bed at the Weir is + 24.50,



1. Model "A"



2. Model "B"



3. Plan of first proposal for Weir

4. Plan of final proposal for Weir

the upper surface of rock being taken at + 22.00. The model of the Weir was made to a scale of 1:50 and the relation between the results of the experiments and those likely to occur in the actual structure was obtained by means of "Model Rules".

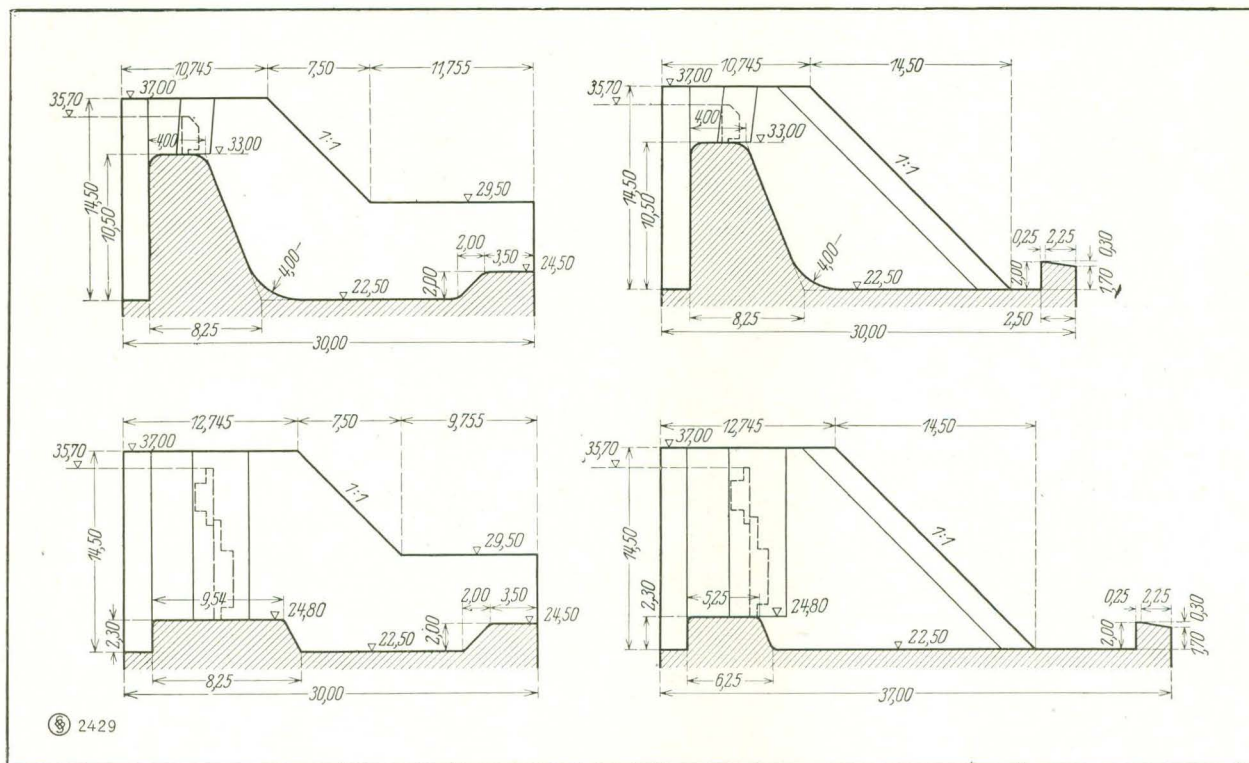
In the preliminary experiments the two deep sluices were situated at the right bank of the river, but, owing to the heavy erosion downstream of these adjacent to the Head Race bank and Intake Works, it was decided to alter their location to the centre of the river, thus giving a more symmetrical flow and confining possible erosion to the centre of the river. These experiments also showed that improvements could be made on the section of the Weir to increase the discharge.

In the succeeding experiments the cross sections of the Weir were altered to the form, indicated from the preliminary experiments, giving an increased discharge and the deep sluices were removed to the centre. The two outside sluices were, however, made $\frac{3}{5}$ their correct width owing to laboratory conditions. Great care was given to the selection of material representing the river bed in the model. Prof. Dr. Ludin selected sieved sand from 2.5 to 5 mm in size as most suitable for representing the sandstone rock of the bed of the river.

The discharge on the model was determined by a calibrated clear overfall weir. For adjustment of water levels hook gauges were fixed one metre above and six metres below the model weir. The discharges measured on the model, when increased according to "Model Rules", gave a practical agreement with theoretical calculations for discharge on the actual weir.

Five experiments were carried out on the modified model "A".

1. One weir sluice (No. 2) opened, rest closed, discharge 141 cbm/sec. upstream water level + 35.70, downstream water level + 25.71, erosion on downstream bed of river carried down to + 19.00, after which erosion was practically unchanged.
2. Three 18 m. sluices (Nos. 1, 2 and 3) open, the rest closed, discharge 414 cbm. per sec. H. W. L. 35.70, L. W. L. 26.88, very little erosion.
3. All 18 m. sluices open and two deep sluices partly and equally open, discharge 920 cbm/sec. H. W. L. 35.57, L. W. L. 28.08, erosion downstream of weir carried down to + 22.00.
4. All 18 m sluices open and one deep sluice partly open, the other closed, discharge 920 cbm/sec.,



5. Section through the upper sluices of first proposal for Weir
6. Section through the deep sluices of first proposal for Weir

7. Section through the upper sluices of final proposal for Weir
8. Section through the deep sluices of final proposal for Weir

H. W. L. 35.57, L. W. L. 28.08, erosion carried down to +19,00.

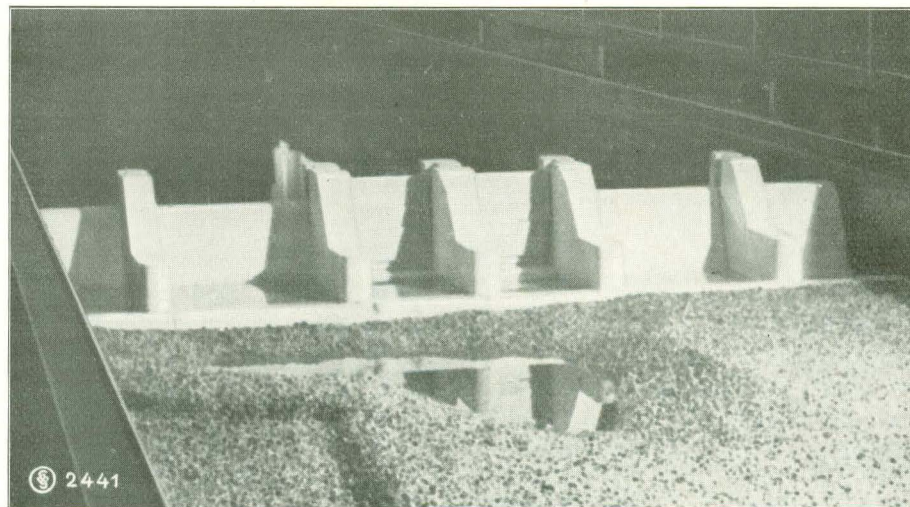
5. Continuous test changing 5 times from low to high water, duration of test 10 hours after which further change in eroded area was practically negligible.

Tests 1 to 4 inclusive were each of one hour duration after which further erosion was negligible. Experiments 1 and 4 gave the worst erosion and although they occurred under very exceptional circumstances, it was decided to carry out further experiments with a view to diminishing the erosion.

Picture 1 shows that in experiments 1 on Model "A" there was no overlapping rolling water; this was partly due to the shape of the cross wall on the downstream toe of the spill basin. Further experiments were made under condition 1 (above) in which the model was altered, first the pier extensions were omitted to allow lateral flow of

water and second a vertical stop wall with crest sloping slightly downstream was adopted giving improved conditions (see Pictures 2 and 10).

Experiment 4 (above) was then reconsidered and an attempt was made to confine the large wave within the spill basin first by omitting pier extensions and altering the shape of the stop wall and second by further lengthening the pier extensions; the erosion was still serious.



9. Model "A" General-View

As a result of further experiments in which extension of piers was increased, height of these extensions varied, length of spill basin increased and Prof. Rehbock's toothed stopwall adopted, Model "B" was constructed; this model did not, however, embody Prof. Rehbock's toothed stopwall, as an almost equally satisfactory result was obtained with a continuous wall having a vertical face and horizontal sill slightly inclined in a downstream direction.

Five experiments were then carried out on Model "B", these experiments being performed with the same conditions as for

Model "A". Under all conditions the depth of erosion was less than in Model "A", the greatest erosion (down to level 19.90) taking place in experiment 5.

A new set of experiments were carried out under conditions likely to occur under Partial development, i. e. Weir crests of 18 m. openings were reduced to +30.85 and H.W. L. fixed at +33.55. The erosion was in all cases less than under Full development conditions.

Overload conditions on Models "A" and "B" were compared, the experiments showing in all cases least erosion for Model "B".

From observations of the various experiments it was thought that by reducing the discharge through the deep sluices and correspondingly increasing the discharge through the 18.0 m. sluices for a max. flow of 920 cbm/sec., the erosion would be decreased. Under Full development conditions the crests of the 18.0 m. openings were arranged as follows, Weir openings Nos. 1 and 4 +33.00, Weir openings Nos. 2 and 3 +32.20, and experiments were made. Further alterations were tried on pier extensions at the deep sluices, and on a section for the stop wall. The experiments showed that the pier extensions were objectionable and that the stop wall adopted for Model "B" was satisfactory. The guide partitions or pier extensions were now abandoned and experiments carried out

under practically the same conditions as 5 "A" and 5 "B". The experiment was repeated 5 times i. e. total duration of flow 10 hours and gave maximum depth of erosion down to +21.25. The discharge for this experiment was:

$$132 + 197 + 131 + 131 + 132 = 920 \text{ cbm/sec.}$$

for all sluices open.

$$\text{and } 132 + 197 + 262 + 0 + 197 + 132 = 920 \text{ cbm/sec.}$$

for one deep sluice closed.

The crests of 18m. Weir openings 2 and 3 were then increased to level +32.40 and the discharge arranged as follows: —

$$132 + 180 +$$

$$148 + 148 +$$

180 + 132 = 920 cbm/sec. all sluices open.

$$132 + 180 + 296 + 0 + 180 + 132 = 920 \text{ cbm/sec.}$$

one deep sluice closed.

The result of this experiment 5D gave erosion to level +21.00.

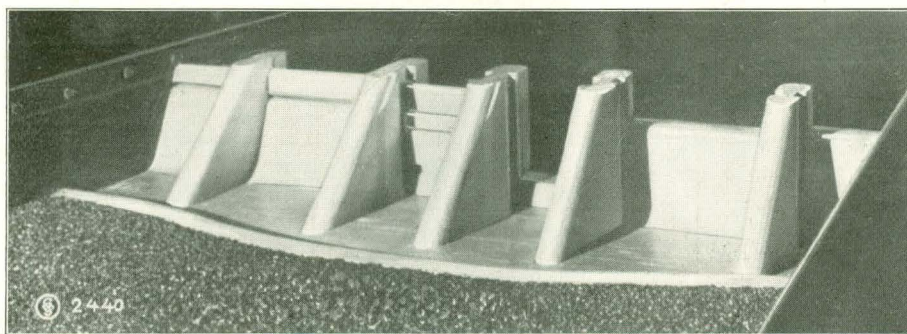
The effect of using finer sand for the bed of the river was tried next Model "D" being adopted. An experiment 5 E similar to 5 B was made and gave erosion down to a maximum depth of 18.35 m. From the form of this erosion on the model no danger to the safety of the structure can be anticipated.

A further experiment 5 F was carried out in which Model C with minor alterations to stop wall were tried, but practically no alterations in the eroded river bed were found.

Auxiliary experiments were made resulting in

- a) the rounding off of downstream faces of weir piers,
- b) omission of extension of weir piers,
- c) reduction of width of inlet sills of deep sluices from 9.54 m. to 5.25 m,
- d) adoption of stop wall 2.0 m. high above floor of spill basin.

As a result of these experiments Model "C" was adopted together with the modifications of Model F, thus giving a final design for Weir shown on Pictures 3—8.



10. Model "D" General-View