OKSHTUNI RCC DAM
(First RCC Large Dam in Albania)

Dr. Fahri MAHO[1], eng. Arjan JOVANI[2]
[1]*Designer of Okshtuni RCC Dam and CEO of EBS shpk, Tirana, 1019, Albania*
Email: f_maho@yahoo.com

[2]*Member of DSC/ICOLD and Reviewer of Okshtuni Dam Design, DSC/ICOLD, Tirana, 1018, Albania*
Email: jovania60@yahoo.com

ABSTRACT: This paper regards the Okshtuni RCC Dam as first RCC Dam in Albania give e description on main data of this dam and briefly information on the design criteria and analyses. Okshtuni RCC Dam is part of the Hydroelectric scheme of Okshtuni River given with Concession to an Albanian company of DITEKO ltd. Okshtuni river is branch of Drini river which is largest River in Albania. Drini river bed in northern Albania has been transformed into a chain of three reservoirs with total water capacity of 3.4 billion m3 which supply water to the largest Hydropower plants (HEPP) of Albania. Three HEPP's and their large dams with height 115 m to 166.5 m are in the Drini River Cascade which is unique in Europe.

Main Purpose of Okshtuni Dam is to store the flow of two river branches and raise the head by about 55 m out of gross head of 191 m of the Okshtuni HEPP. The water storage of the Reservoir created by this dam is 10 million m3 and assure a few daily regulation of the river flow to be used mainly as pick flow of HEPP. The gross head 146 m is created by a pressure buried derivation pipe with DN=2.0 m, length L=6.5 km built along the Okshtuni river bed.

This paper summarizes the main technical data of Okshtuni RCC Dam, Design Criteria and Analyse. It is intended to evidence the advantages of this kind of dam and some specific conditions of the area near of this dam.

Keywords: Okshtuni RCC Dam, Drini River, HEPP, Clay Core, RCC, Spillway

1. INTRODUCTION

The Okshtuni HEPP is part of the hydroelectric scheme of Okshtuni River given with Concession to an Albanian Company, DITEKO Ltd. The main purpose of the dam is to store the flows of two river branches and raise the head by about 55 m out of gross head of 191 m of the Okshtuni HEPP. The water storage of the reservoir created by the dam is 10 million m^3 and assure a few dailys regulation of the river flow to be used mainly as pick flow HPP.

The installed capacity of the Okshtuni HPP is 15 MW consisting on three Pelton Turbine 5 MW each.

The gross head 146 m is created by a pressure buried derivation pipe with OD 2 m and length of 6.5 km long built along the river bed.

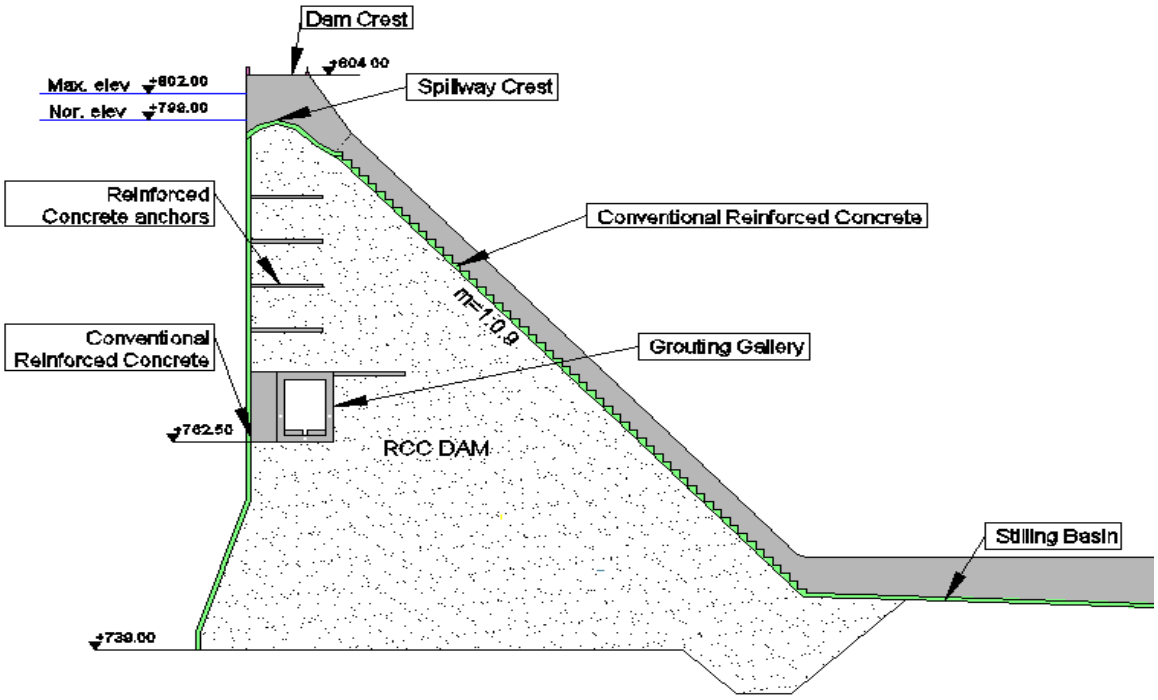
2. MAIN DATA

Okshtuni RCC Dam is designed as gravity RCC dam. It is the first RCC dam in Albania. The height of dam is 65 m and the crest length is 253 m. The volume of RCC is 160 000 m3 and total volume is 195 000 m3.

Purpose of this dam is to store the flow of two branch rivers, raise the gross head of Okshtuni HEPP by about 55 m and assure a few days river flow regulation to be used as pick flow for HEPP

The dam body has started construction on October 2016 and is completed October 2017.

The typical cross section of the Okshtuni dam is shown in the Fig.1



2.1 Foundation

Foundation rock is flysch's formations of Creatic - Pleogen (Cr_{2m}-Pg_{1-2}) age. The flysch's formations are generall thin and medium layers with sandy substrates, alevrolites and marls (sandstone, siltstone and marlstone). The rock structure is generally monoclinal. The scale of lithification of the substrates which represents flysch's formations is high. On the left bank of the valley the flysch's layers has an inclination of 10^0 - 15^0 with opposite direction of terrain slope.

On the right bank of the valley there are delluvio-colluvia coverage of 10-15 m depth, wich has been removed up to the flysch rock with inclination layers of 45^0 - 50^0 with the same direction of the bank slope. The erosion base of the valley under the boulder's proluvions of the river bed represents the compact flysch's layers with high physical parameters.

2.2 Dam Body

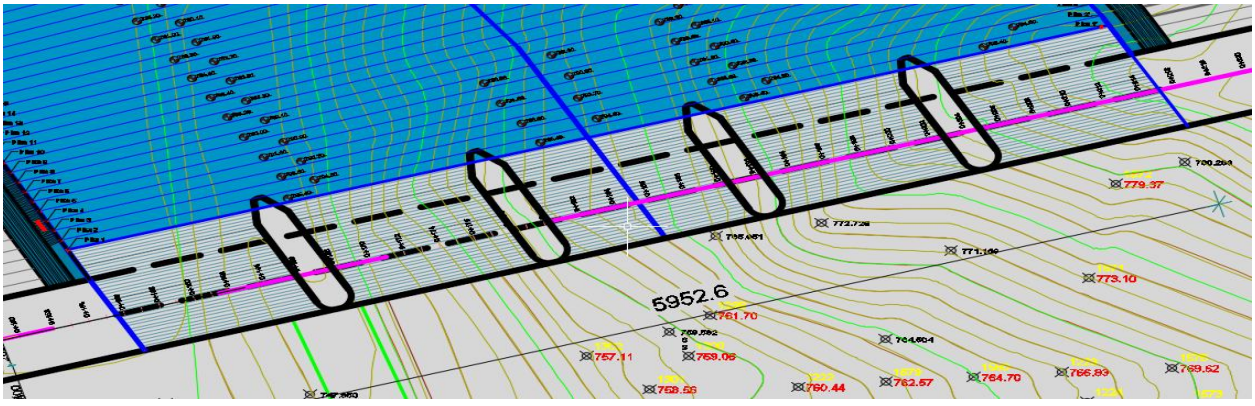
Total volume of dam body is 194 000 m3. The main dam body has been filled with RCC in layers 25-30 cm thick and compacted by a roller 12 ton weight and with 4 return passing. On the upstream side is provided a reinforced conventional concrete in each three layers of RCC with two functions, first to create a stable vertical wall of the upstream dam and second to support the impermeability of the dam body.

The dam body materials is Rolled compacted concrete realized with cement CEM II, 42.5 R, aggregates with size from 0.075 mm to 52 mm and water. The rate Cement / Water is 115/85. The volumetric mass of RCC is 2350 kg/m3 and the permeability is 2.75* 10-2cm/sek.

For fixing the vertical wall to the dam body, reinforced concrete slabs have been casted into the RCC dam body every about 5 m height. The reinforced conventional concrete have been provided in steps in the downstream side as well including the steps of the spillway.

2.3 Spillway

It is designed un ungated spillway with crest length of 60 m in 5 spaces. The spillway is designed to pass a flow of about 825 m3/s routed flood with return period 1 in 10,000 years. The spillway ends to stilling basin designed to still about 60% of the whole energy of the flow on the spillway. The remained energy is supposed to be stilled by the steps 90x90cm on the spillway. See Spillway in the figure below



2.4 Faces and Slopes

Upstream:	Vertical (with convetional reinforced concrete)
Downstream:	V/0.9 (stepped conventional reinforced concrete)
Spillway:	V/0.9 (stepped conventional reinforced concrete)
Thickness:	
• Layers:	300 mm
• Lifts:	300 mm
Cement Content:	110-115 kg/m^3

3. DESIGN CRITERIA AND ANALYSE

3.1 Design Criteria

Axe of Okshtuni dam was selected referred the width of river canyon in the location of dam, the river basin and selection of optimal volume of reservoir and dam, geological condition of location, environmental protection of some specific areas, social aspects in the area, land ownership, construction condition, location of construction materials, etc.

The main design criteries for selection of type of Okshtuni dam has been:

- Condition of dam foundation
- Geological Condition of the dam sides and their stabilities
- Location of Hydraulic structures (spillway, intake, etc)
- Seismic conditions of Area
- Construction Materials for dam body near of dam location
- Minimum leakage from Dam body and sides
- Shortest construction period
- Cost of Construction
- Starting time of dam Operation

3.2 Analyses of proposed Versions and Selection of type for Okshtuni Dam

Referred above design criteria, during the design phase, there are analyzed three types of dams as:

- Rockfill dam with Clay Core
- Rockfill dam with Reinforced concrete face (RCF dam)
- RCC dam

3.2.1 Rockfill dam with clay core. For this kind of dam, we have a lot of experience. In Albania are constructed more than 100 large dams with clay core. During the investigation of the area, Designer have seen that the filling materials was 10 km near of dam location and materials for clay core was more than 20 km from dam.

The volume of filling materials for dam is foreseen to be approx. 460 000 m3 and the volume of clay core was foreseen to be 120 000 m3.

Construction of Deviation tunnel was difficult and the construction cost was high. Construction of reinforced concrete and galleries was difficult.

3.2.2 Rockfill dam with reinforced concrete face. For this type of dam, we have a few experience. In Albania are constructed 4-5 large dams with reinforced concrete face. The largest dam with RCF is Komani dam with height 115 m.

The volume of dam for this version is approx. 580 000 m3. During the investigation of the area, Designer have seen that the filling materials was 10 km near of dam location.

Construction Cost was higher from other version. Construction of reinforced concrete and galleries was difficult. From previous experience, the leakages from dam body are higher than other versions. The seismic conditions in this area are problematic for this kind of dam. Length of anti filtration screen is large and the cost is high. Deviation tunnel was foreseen to be with high construction cost

3.2.3 Roller Compacted Concrete Dam. For this type of dam, we had not any previous experience. In Albania, It is the first RCC dam. We had a few experience for construction of concrete gravity dams.

The Total volume of dam for this version is calculated to be approx. 195 000 m3. The concrete materials (aggregate, sand, gravel, water, ect) was 10 near of dam location. The construction of grouting galleries inside the dam body was not difficult. Grouting and control gallery will be constructed inside the dam body. The construction of cemented screen for anti filtration protection measures was not difficult. The construction period was shortest than other versions.

The Construction cost was smaller than other versions. The using of formworks was less than typical concrete gravity dams. Spillway will be included in the dam body and the construction volume and cost will be reduced. The operation during the flood period was better. Deviation tunnel was shortest. Construction of Intake on the dam body was not difficult

After the technical and economical analyze for all above types, Designer decided to construct RCC dam.

4. CONCLUSION

- Construction of Okshtuni RCC Dam was effective and economic.
- The spillway and Intake on the dam body is very good technical solution. All elements of dam are compacted and very well operation
- The hydraulic structures in the dam body increase their stability against the seismic risk
- Deviation tunnel during the construction phase was shorter and the cost was not high.
- The Leakage from dam body was very small in some areas near of the left side. They are under the control and they can be checked and monitored by experts in easy way.
- The excavations on the both sides of dam were reduced. This reduce the risks for any damage of geological conditions and increase the stability of both sides.
- Using of Machineries with high technology was possible and effective.
- Construction conditions during the implementation phase was better and the construction period was shortest.

5. PHOTOS

Overview during the construction, 2018

Overview during the construction, 2018

After Completion, May 2019

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