

## G E O L O G I C A L   E n g i n e e r i n g   A s p e c t s   o f t h e   L e n d   D a m   i n   S o u t h   E a s t   O F   I r a n

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### 1- INTRODUCTION

In this article the engineering geological study of the dam site, will be presented. The Lend dam, 21 m high, 2148 m crest length,  $23.3 \times 10^6 \text{ m}^3$  dam's reservoir volume, is planned to be constructed at north part of Chabahar city, south eastern part of Iran. The aim of this dam is to irrigate the downstream valley, to improve the water provision to neighboring villages and to avoid eventual flooding.

### 2- GEOLOGICAL OBSERVATION FEATURES IN THE DAM SITE

From geological point of view the study area is located in Makran zone. The dam site was studied on the surface with detail engineering geological mapping and in the subsurface with drilling 14 boreholes. As the results of these investigations the following condition were determined.

#### 2.1- Lithology

Rock making up the right abutment is a Neogene stratified sandstone. The sandstone are made up of varying bed thickness which based on bed thickness, the rock is classified into four groups namely ss1 ~ ss4. The left abutment is formed by shaly layers. The foundation rocks corresponds to both sandstone and shaly layers with maximum 8 m of alluvial deposits at the bed river.

#### 2.2- Structural Geology

The right ridge of the dam forms a local anticlinal, where the anticlinal axis plunges toward the dam foundation. The anticlinal has created several sets of joints, which the tensional joints is the most important. In the left abutment, the shaly beds forms several local folds which mostly are asymmetric folds.

Investigation and measurement of the joint system was performed and the results were prepared in the form of rose diagram and stereogram projection. The result clarified that in general two groups of joints can be observed, systematic joints and nonsystematic joints.

The systematic joints are as a result of tectonical forces and mostly are related to the local folding in that area. The nonsystematic joints are surficial and are attributed to the weathering phenomenon in sandstone layer and shrinkage crack in shaly beds.

There are several type of local faults in the dam site, which in some cases 20 m displacement could be measured. In the right abutment, local faults caused displacement of layers at the flank of the anticline.

### 3- IN SITU AND LABORATORY TESTS

To find out about the engineering geological characteristics of the rock mass in the dam site, field procedures and laboratory tests were performed.

#### 3.1- Permeability

Single packer permeability tests were carried out at 1.0m interval and under 3,5,7 atmosphere pressures in all drilled the boreholes in the dam foundation area. The

results revealed that the left abutment of the dam is almost impermeable. The right abutment due to several joints and surficial weathering is slightly permeable.

### 3.1.1- Laboratory Tests

The core samples were tested for physical and mechanical properties including density, water absorption, porosity, uniaxial compressive strength, modules of elasticity, and poisson's ratio.

### 3.2- Rock mass classification

From the geological investigation and performed indexing tests, the rock mass was rated and classified, using Bieniawski's R.M.R., into two classes, namely, class (III) fair rock and class (IV) poor rock, shown in Table (1).

Table 1. Rock mass classification(R.M.R.)

PARAMETER	LEFT BLANK		RATING		RIGHT BLANK		RATING	
	D. *	S. *	D.	S.	D.	S.	D.	S.
Un. Com. Str. Mpa	3~10	1~3	1	0	80~90	44~50	8	5
R. Q. D.	15		3		60		13	
Joints Spacing cm	5		8		31		22	
Joint Condition	smooth - rough aperture 2mm		6		smooth - rough aperture 5mm		6	
Ground Water Condit.	dry ~ moist		7		completely dry		10	
Joint Orientation	fair~favorable		-3		favorable		-2	
Total of Ratio	————		22	21	————		57	54

D. \*: Dry , S. \*: Saturation

TYPE OF ROCK	CONDATION	RATING	CLASS	DESCRIPTION
Sandstone	dry	57	III	fair rock
	saturated	54	III	fair rock
Shale	dry	22	IV	poor rock
	saturated	21	IV	poor rock

### 4- CONCLUDING REMARKS

According to the site investigation and field tests the following comments are proposed.

- 1: Due to existence of local faults in the right abutment, drilling of several boreholes is proposed to identify fractured zone.
- 2: The drilled borehole can be used for grouting for water tightness of sandstone layers.
- 3: As shaly layers in the surficial part are weathered with weak geotechnical characteristics, removed of weathered part is proposed.
- 4: Removal of alluvial deposits in the dam foundation also is commented.

### REFERENCES

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- 3) Hoek E. and Brown E. T.: Underground Excavations in Rock, 1980.