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A Contribution to the History of Water Management and Dams: The Roman and Medieval Hydraulic Structures on the Rio Grande Stream, Amelia (Umbria, Italy)

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Abstract This paper describes some ancient hydraulic structures located along the Rio Grande stream (Amelia, Central Italy). The main structures are two large dams, not previously mentioned in the literature on dam’s history. One of the two dams is an arch dam, already existing in 1427, while the other one is probably of Roman age. The main purpose of the two dams, both higher than 15 m, was to provide water to not less than three water-mills. Both reservoirs may possibly have also been used for irrigation and fishery.

Keywords: Amelia; Arch Dam; Italy; History of Dams; Para Dam; Rio Grande Dam

INTRODUCTION

This paper presents the first results of an investigation regarding two little known ancient dams on the Rio Grande (or Fosso Grande) stream, tributary of Tiber River, in the territory of the town of Amelia (Central Italy, Figure 1). As far as we know, the two dams are not mentioned in any publications dealing with the history of dams (see for instance Smith, 1971; Schnitter, 1994) nor in an old but authoritative list of Italian dams (Ghetti and Tonini, 1960): indeed it is not even known when the dams were built. Figure 1 is a geological map of the area where the two dams are located; in the map the dams are identified by the numbers 1 and 2, in red. The present names of the dams are Para (n. 1) and Rio Grande Dam (n. 2). Figure 2 shows a general view of the site, looking from North-East towards South-West. It has to be noted that, from the engineering and geological modern point of view, both dams are located in an excellent position.

THE PARA DAM

The Para (Figure 3) is an arch dam. It is about 15 m high; at the top we measured a thickness of 1.8 m and an arch length of 51 m. We were not able to measure the thickness at the bottom, which seems to be 2-3 times larger than at the top. The dam, resting on a thick rectilinear basement, was built with small limestone blocks, typical of Middle Age; the reservoir is at present completely silted (Figure 4). The overflow spillway visible in Figure 3 is modern, as it was build at the end of 1950s (Manciola, 2000). The original spillway is a channel, at present in very poor conditions, located on the right hydrographic site of the river, slightly higher than the modern spillway (Figure 5). The original spillway was in part dug in the limestone and in part built with limestone blocks. On the upstream site of the old spillway, some remnants of a brick floor are still visible. There is evidence that a vault, now collapsed, covered the old spillway. The dam has a bottom discharge conduit (its exit can be seen on the right of the water fall in Figure 3), but the way it was operated is unclear. An obvious raison d’etre of the Para Dam was the water-mill located on the left side of the river (Figure 3); the other reason may possibly have been its use as a reservoir for irrigation and fishery. It is not known when the dam was build, but it is known that in 1427 A.D. the dam was under construction or reconstruction (Di Tommaso, 1931).
Figure 1. Geological map of the area where the Para Dam (1) and the Ponte Grande Dam (2) are located. The rock formation where the two dams have been built is a massive limestone (MAS, blue color on the map). In the map the rocks indicated with MAS, COI, CDU, MAI, SBI, SAA correspond to hard rocks, while the other are marls, clay and sands (modified after Regione Umbria, 2006).

Figure 2. General view of the valley where the Para Dam (1) and the Rio Grande Dam (2) are located. In the background, on the hill, there is the town of Amelia. Notice that this picture is oriented in the opposite direction of the map in Figure 1. (Modified Google Earth picture). Some documents written in the XIII and XIV centuries A.D., mention casually a “Para” and some water mills existing in the years 1203, 1328 and 1331 (Spagnoli, 2009). According to A. Della Rosa, who conducted a large investigation about the history of the area, the Para Dam can be traced back to the XII century (reported in Manciola, 2000).
Figure 3. The Para Dam. The construction on the right site is an old water mill.

Figure 4. The reservoir of the Para Dam is entirely silted. The crest of the dam appears to be a late elevation.
Figure 5. A view of the original spillway of the Para Dam and the present overflow spillway.

THE RIO GRANDE DAM

Figures 6, 7, 8 report various views of the Rio Grande Dam. The dam is about 20 m high; it is made of two straight walls, both vertical on the upstream side, and sloping by only 3° out of the vertical on the downstream side. The two walls are long 37 and 47 m, and meet at an angle of 150°, with the concavity downstream; the thickness of the walls at the base is around 11.5 m, while the crest has a thickness of 7 m (Manciola 2000). On top of the dam there is a bridge, bearing a modern road. The empty spaces between the piers of the bridge act as overflow spillways. The bridge was built around 1880; during the Second World War it was bombed by British and USA air forces, a pier was destroyed and rebuilt after the war. In spite of all that, the dam was not damaged. Nothing sure is known about the time when the dam was built. According to Giovanni Stocchi, the engineer who built the bridge around 1880, the dam is Roman (reported in Della Rosa, 1989). This is likely: in Roman times, Amelia was an important town, called Ameria. The town gave its name to an important road (Amerina Road), which in order to cross the Rio Grande needed a bridge, which could be in the same place where the modern one is. Indeed the location of the bridge (and of the dam) appears to be the best in terms of bridge length and use for the town. Di Tommaso (1931) reports, with some doubts, that the Roman Emperor Aurelian (A.D. 270 – 275) built a bridge and carried out other hydraulic works in Ameria.

The Rio Grande Dam was used by at least two water mills, one located just at the foot of the dam (Figure 7), another about one kilometre downstream, close to a medieval bridge (Figure 9): some tracts of a canal bringing the water to the second mill, at the proper elevation, can still be seen along the Rio Grande. Apparently the same result (having water for a water mill one kilometre or so downstream of the Rio Grande Dam) could be obtained just building a little weir in the place where the second mill is located: probably this choice, more economical, was discarded because the gorge of the Rio Grande, downstream of the Rio Grande Dam, is karstified and fractured (Figure 10), so that most of the water entering the gorge during the dry season infiltrates towards a regional groundwater flow (Di Matteo et al.,...
2009). As in the case of the Para, the reservoir may possibly have also been used for irrigation and fishery. Today the reservoir of the Rio Grande Dam is entirely silted up (Figure 11).

**Figure 6.** The Rio Grande Dam and the bridge on top of it. On the right side of the photo, out of view, there are the remnants of a water mill (cf. Figure 7).

**Figure 7.** A sight of the water-mill remnants, just downstream of the Rio Grande Dam. In the background, one pier of the bridge on the dam’s crest can be seen.
Figure 8. Another view of the Rio Grande Dam and bridge.

Figure 9. The medieval bridge downstream of the Rio Grande Dam.
Figure 10. A view of the gorge of Rio Grande, downstream of the Rio Grande Dam. Considering karstification and fractures of the rock, it is likely that a high percentage of water flow during summer (the dry season) is lost, recharging a regional karstic aquifer. Probably for this reason, in order to bring water to a third mill, it was necessary to build a canal about one kilometre long, downstream of the Rio Grande Dam.

Figure 11. The reservoir created by the Rio Grande Dam is entirely silted. On the background of the picture two piers of the bridge on top of the dam can be seen.
FINAL CONSIDERATIONS

The hydraulics structures on the Rio Grande appear to be of a certain importance for the history of dams. The Para Dam dates back at least to the beginning of the XV century A.D. and if, since that time, the dam has not been rebuilt, the Para would contradict the belief that the first arch dam in Europe (after the end of the Roman Empire) was built in 1611, on the River Fersina (Trento, North Italy), or in Elche, Spain, in 1632-1640 (Smith, 1971; Schnitter, 1994). The importance of the site is exalted by the Rio Grande Dam, which is probably one of the relatively few Roman dams surviving in Italy. In any case, further archive and field researches are necessary to improve the knowledge about the history of the dams on Rio Grande of Amelia.

At present there is a concern about the safety of these two dams, which need urgent repairs both from the point of view of floods and earthquakes (the poor conditions of the Para Dam bottom discharge can be seen in Figure 3). The Government made plans in order to make them safe: due to their technical and historical relevance, it is necessary that the intervention is done without altering much the two structures and the beauty of the places.

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