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A REVIEW OF THE FLOW REGULATION SYSTEM ON THE SECCHIA AND PANARO RIVERS (MODENA AREA, ITALY) (**)

Abstract: CASTALDINI D. & PELLEGRINI M., *A review of the flow regulation systems on the Secchia and Panaro rivers (Modena area, Italy).*

The Secchia and Panaro rivers form a scissors-like course around Modena. These two rivers have periodically caused flooding in the area of Modena. The more recent floods took place mainly between 1960 and 1973 and were largely determined by changes in the flow and transfer velocity of the volume of water in the beds. Flow regulation devices were planned and constructed in areas adjacent to the courses of the two rivers in order to control these hydrological hazards in the area of Modena.

The flow regulation systems have been in operation since 1979 (for the Secchia R.) and 1985 (for the Panaro R.). They have constructed in the toe areas of the Secchia and Panaro rivers fans within channels that are approximately 2 km wide and that are bordered by banks several metres high.

The flow regulation systems are located in a geomorphological situation that is optimal for storing large volumes of water without necessitating major works for such purposes. The two structures consist principally of a regulating dam built across the bed and a storage basin bordered by embankments.

Their most important function is to reduce the flood peak, that is, they intervene on only a limited scale.

The flow regulation systems for the Secchia and Panaro rivers have not yet been tested as to their efficiency under flood conditions for which they were built. The systems were planned for major flood events, however, none have occurred since their completion.

KEY WORDS: Flood hazard, Flow regulation system, Secchia river, Panaro river, Modena (Italy).

Riassunto: CASTALDINI D. & PELLEGRINI M., *Rassegna sulle casse di espansione dei fiumi Secchia e Panaro (Provincia di Modena, Italia).*

I fiumi Secchia e Panaro scorrono ai lati di Modena descrivendo una specie di forbice. Il Secchia ed il Panaro con le loro acque hanno periodicamente allagato vaste aree in prossimità di Modena. Le alluvioni più recenti, che si sono verificate principalmente tra il 1960 e il 1973, sono state prevalentemente determinate da cambiamenti di flusso e di velocità di corrivazione del volune d'acqua nei letti fluviali. Per difendere l'area di Modena dal rischio da alluvioni sono state progettate e costruite due «casse di espansione», in aree adiacenti ai corsi dei due fiumi.

Le «casse di espansione» del Secchia e del Panaro (in funzione rispettivamente dal 1979 e dal 1985) sono state ubicate al piede dei conoidi dei fiumi suddetti all'interno di solchi larghi circa 2 km e delimitati lateralmente da scarpate fluviali alte qualche metro. Sono situate in una situazione geomorfologica che è ideale per invasare grandi volumi d'acqua senza enormi opere di contenimento.

Le casse di espansione consistono principalmente in un manufatto regolatore costruito traversalmente al letto del fiume e in un bacino d'espansione bordato da argini. Lo scopo principale delle casse di espansione è quello di regolare l'onda di piena cioè di intervenire su una capacità d'acqua molto limitata, ma con un'altezza idrometrica elevata. Le casse di espansione del Panaro e del Secchia non sono ancora state collaudate in relazione ai maggiori eventi di piena per cui sono state costruite, ma che non si sono più verificati dall'epoca del loro completamento.

TERMINI CHIAVE: Rischio da alluvioni, Casse di espansione, Fiume Panaro, Fiume Secchia, Modena (Italia).

The Secchia and Panaro Rivers are the last affluents on the right side of the Po River; they collect water from the central section of the Emilian Apennines (the Secchia River has a mountain-basin of 1292 km^2; the Panaro River mountain-basin extends over an area of 1035 km^2) and they flow through the outskirts of Modena, the Secchia to the east of the city, and the Panaro to the West. After forming a scissors-like course around Modena, they flow tortuously to the NE between high banks until their confluence with the Po River. At the points where they flow on to the plain, the rivers coming from the Apennines formed large alluvial fans during the Quaternary; these are characterized by sandy gravels alternating with silty and clayey deposits, both at the surface and at depth.

The Secchia river fan, with its head in the vicinity of Sassuolo (fig. 1), is asymmetrical with respect to the present course of the river, which has shifted to the western margin. Its length is about 20 km and the maximum width is 14 km. The fan is almost flat and presents, longitudinally, a double gradient: there is an average slope of 0.7% in the upper part and 0.3% in the lower part. Overlying marine clays of the Pliocene-Quaternary, the fan is made up of four overlapping lithological units, three of which are identifia-

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