

# GEOMEMBRANE UPSTREAM EMBANKMENT DAM BARRIER OSPEDALE AND CODOLE DAMS, CORSICA, FRANCE

C. Tisserand  
Somivac  
Corsica, France

J.P. Gourc  
Irigm-UJF  
Grenoble, France

To the authors' knowledge, the Ospedale dam is the first dam more than 20 m high ever built with a waterproofing system consisting of a geomembrane. Construction work on this dam was completed in 1978. This was then followed by construction of the Codole dam. The Codole dam was completed in 1983. It is also located in Corsica and designed according to the same model.

## GENERAL CONTEXT

Owing to its relief, Corsica is at a disadvantage concerning its natural water supply. This is principally due to the short distance between the central mountain range and the coastline. The water supply problem has become more acute as tourism and agricultural development has led to greater demands for drinking and irrigation water.

## DESCRIPTION OF THE TWO DAMS

The two dams are of the rockfill type sealed by a thin upstream lining. The main component of this lining is its geomembrane. The main features of these dams are given in Table 1.

## CHOICE OF A GEOMEMBRANE UPSTREAM FACING

The initial design of the Ospedale dam provided for a 0.24 m thick asphaltic concrete upstream facing. This

Table 1. Details of dams.		
	Ospedale	Codole
Reservoir level (m)	950	115
Reservoir capacity (m <sup>3</sup> )	3,000,000	6,500,000
Dam height (m)	25	28
Crest length (m)	135	460
Base width (m)	90	95
Upstream slope	1.7H:1V	1.7H:1V

solution was estimated to be extremely costly due to three main factors (1) the small surface area of the facing (3,800 m<sup>2</sup>), (2) the limited height of the dam and, (3) the geographical location of the site (1,000 m altitude). It was for this reason that the "geomembrane" choice was selected (it was estimated to cost 30% less). This solution was favourably received by the Comité Technique Permanent des Barrages (Permanent Technical Committee on Dams). This Committee was set up by the French authorities, following the collapse of the Malpasset dam in 1962. Their task is to approve the design and proposed construction methods of all French dams exceeding 20 m in height.

In view of the excellent results obtained on the Ospedale dam, and considering its great similarity to

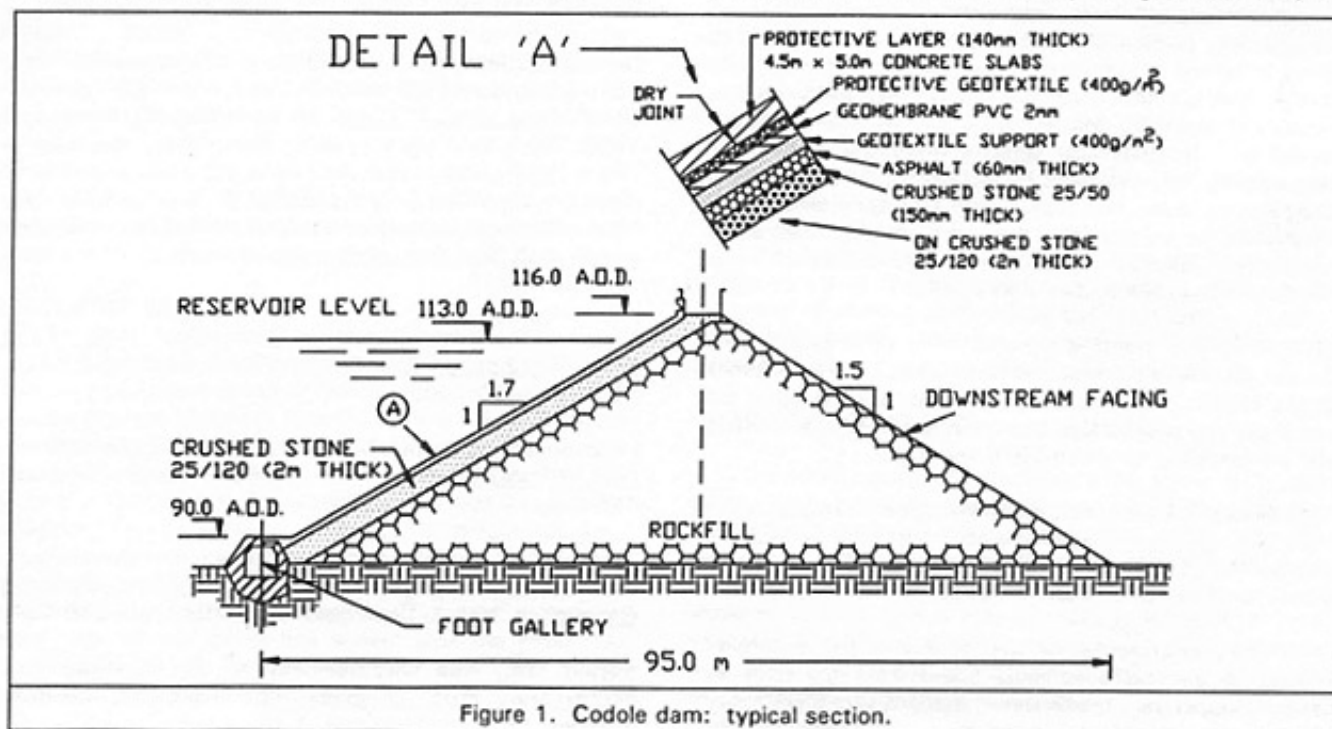




Photo 1. Codole dam: nearing completion.



Photo 2. Codole dam: placing of upstream geomembrane.

Codole dam, the "geomembrane" solution was also chosen for Ospedale dam.

Geomembrane waterproofing involves three main components: the support layer, the waterproof lining and the protective layer.

#### Support Layer for Waterproof Lining

In order to obtain a satisfactory transition between the waterproofing material and the body of the rockfill dam, a layer of 25/120 mm crushed stone was first placed for both dams to a thickness of 2 m. This base layer was then covered with 150 mm of 25/50 mm crushed stone impregnated with bitumen. To eliminate any surface defects a top-surface course (60 mm thick) of 3/5 mm asphalt was then applied.

#### Waterproof Lining

The geomembrane is separated from the support by a layer of nonwoven polyester geotextile (270 g/m<sup>2</sup> Bidim at Ospedale and 400 g/m<sup>2</sup> Geosom at Codole). The geotextile's purpose was to prevent any holes being punched in the geomembrane. The geomembrane used at Ospedale is a bituminous membrane reinforced with polyester felt, while at Codole, a non reinforced PVC was used. The main features are shown in Table 2.

The strips of bituminous geomembrane at Ospedale were heat-welded together by a special hot-air machine, with 300 mm overlap of adjacent strips. These heat-welded geomembrane seams were inspected by an ultrasonic tester.

The PVC geomembranes at Codole dam were heat-welded manually by means of welding torches, with a 50 mm overlap of adjacent strips. Then the seam welds were inspected by electronic scanning, although visual inspection was found more efficient.

#### Protective Layer

The outer layer was necessary so as to weight the geomembrane in place (i.e. to prevent it being torn away by wind, waves, etc.) and to protect it from external agents (heat, ultraviolet rays, impacts, etc.)

At Ospedale, this protective layer consisted of 80 mm thick interlocking concrete paving blocks. These blocks were laid by hand on a nonwoven geotextile. At Codole, this protective layer consisted of 140 mm thick, 4.5 m x 5 m concrete slabs.

Table 2. Main features of geomembranes.

	Ospedale	Codole
Geomembrane	Coletanche NTP3	TERSOM V20/10
Thickness (mm)	4.8	2
Tensile strength (kN/m)	14 to 21	17
Strain (%)	59	170
Bursting pressure (kPa)	800	> 1200

#### PERFORMANCE

Since their completion, the waterproofing systems has proved satisfactory. A total leakage rate measured is about 1 litre/s at Ospedale, and 2 litres/s at Codole.

The only problem raised by this new technique was the stability of the interlocking paving blocks. At Ospedale dam, an area of 350 m<sup>2</sup> of this protecting facing was disrupted during severe storms over the reservoir. The two major factors responsible for this deterioration were wave action and the relatively steep slope of the facing (1.7H:1V). Scale model tests (1:5) carried out at Cemagref laboratories showed uplift pressures under the blocks during wave backwash. This resulted in a new design for the repair work.

#### CONCLUSION

The first major dam constructed with a geomembrane waterproof upstream facing has, after ten years of service, given ample proof of high performance. The technique was easy to install, inspect and repair. There were significant savings over the more conventional methods.

#### REFERENCES

Bianchi, C., Rocca-Serra, C., and Girollet, J., "Utilisation d'un revêtement mince pour l'étanchéité d'un barrage de plus de 20 m de hauteur" Proc. of the 13th. Congress on Large Dams, C11, New Delhi, 1979, pp. 173-186.

Grossmann, A., "Le Barrage de Codole: une seconde expérience d'étanchéité par membrane mince sur un grand barrage" Proc. of Colloquium on surface waterproofing of basins, dams and canals, Session 4, Cemagref, Paris, Feb. 1983, pp. 171-174.

Labre, J. and Loudière, D., "Design of fill dams including a geomembrane" Proc. of Int. Conf. on Geomembranes, Denver 1984.