1 A Brief history

The Malpasset Dam was built for irrigation and the storage of drinking water. It was located in a narrow gorge of the Reyran river valley, in the Departement of Var, approximately 12 km upstream of Frejus on the French Riviera. The dam was a double curvature arch dam of 66.5 m maximum height, with a crest length of 223 m. The maximum reservoir capacity was meant to be 55 106 m3 however the dam failed explosively at night in December 1959 - more precisely at 21:14 on 2nd December. The filling of the reservoir had first been very slow, but the last 4 m had been filled in 3 days, because of exceptionally heavy rain in the preceding days. To cope with the flood, the bottom outlet gate had been opened at 18:00 to control the rising reservoir.
The flood wave ran along the Reyran valley to Frejus. A total of 433 casualties were reported.
Little of the dam arch remained, and a deep trough was cut through the rock foundations on the left bank. 1.5 km downstream, a 800 m portion of the Esterel freeway and a bridge were destroyed. Huge blocks were carried out and deposited downstream. Trace marks of the flood wave show that the flood rose to a level as high as 20 m above the original bed level.

Investigations after the accident showed that key factors in the failure of the dam were the pore water pressure in the rock, and the nature of the rock. Under the increasing pressure of rising water, the arch separated from its foundation and rotated as a whole about its upper right end. The whole left side of the dam collapsed, followed by the middle part, and then the right supports.

After this accident, regulations were laid down in France obliging dam owners to undertake dambreak analyses.

2 Topography:

2.1 General description:

Because of the dramatic changes in the topography after the accident, ancient maps (carte 1/20 000 IGN map of Saint-Tropez n°3, dated 1931) have been used to digitise the bottom elevation of the valley. Downstream of the dam, the valley is rather sunken, with two narrow bends. Then the valley widens as some river and brook tributaries join the Reyran. Further downstream tt becomes narrow again before large bends and eventually reaching the flat plain (see figure 1).
The overall dimensions of the study reach are 17 500 m x 9000 m. Elevation of the valley floor (as digitised) ranges from -20 m ABS (the sea is included in the computation) to +100 m ABS, the latter being the estimated initial free surface elevation in the reservoir. The uncertainty on this initial free surface is about 50 cm. This is not significant when considering wave propagation time and maximum water levels.

The topography file contains 13541 points (MALP.GEO), corresponding to the mesh (triangles) used at LNH.

2.2 Singularities

These singularities are not included in the topography file.

- The dam was not completely destroyed.
  The concrete remains could be modelled as a weir of which the crest level is 56,8 m ABS, but it is not necessary in a first computation.

- 1.5 km downstream the dam : the Esterel freeway embankments
  The bridge and a 800 m portion of the freeway has been flooded away.

- 9,5 km downstream the dam : The embankment of the Nice-Marseille railway

For the two last singularities, the data are not available. The analysis on the physical model has shown that the embankments of the Esterel freeway have just a local influence.
We have no information about the behavior of the embankment of the Nice-Marseille railway. Moreover, the physical model can't provide us information because the downstream boundary of the physical model is just upstream this singularity.

3 An overview of the proposed test programme :

We propose to the modellers to achieve simulation with the following conditions which are the same as for the physical model and very closed to the real incident.

3.1 Initial conditions :

The dam may be considered as a straight line between the points of (X,Y) coordinates being (4701.18 m , 4143.41 m) and (4655.5 m, 4392.10 m). Moreover, the concrete remains are not taken into account.
The reservoir level may be taken as constant and equal to 100 m ABS.
The level of the sea is constant and equal to zero.
Except in the reservoir and in the sea, the bottom is dry although the outlet gate was opened but the exact value of discharge is unknown.

3.2 Boundary conditions :

Upstream of the reservoir: the value of the inlet discharge is unknown, so we have imposed a discharge constant equal to zero.
The level at the sea remains constant and equal to zero.

3.3 Physical parameters :

The Strickler coefficient is estimated to be in the range of 30-40. For at least one simulation, the Strickler coefficient should be fixed at 30.

4 The available data :

4.1 Field data:

The main field data are:

Propagation times of the flood wave. 3 electric transformers were destroyed by the wave and the exact times of these shutdowns are known. The transformers are denoted A, B and C and their position is shown in Figure 1 and given explicitly in Table 1. Since transformer A was in the bottom of the valley, the shutdown time here is the wave arrival time. For the other two transformers (B & C), the shutdown time is probably somewhere between the wave arrival time and the time of peak water level.

Electric transformer	Coordinates X	Coordinates Y
A	5550	4400
B	11900	3250
C	13000	2700

Table 1 : coordinates of the electric transformers

A survey was done by the local police that shows the high water mark on both the left and right banks.
Nearly 100 points along the banks have been surveyed. Among these points, we have chosen the most significant. It is important to notice that the location of these points is not very precised.
The coordinates of these points called (P1, P2, ...P17) are given in Table 2.

Points surveyed by the police	Coordinate X	Coordinate Y
P1	4913.1	4244.0
P2	5159.7	4369.6
P3	5790.6	4177.7
P4	5886.5	4503.9
P5	6763.0	3429.6
P6	6929.9	3591.8
P7	7326.0	2948.7

P8	7451.0	3232.1
P9	8735.9	3264.6
P10	8628.6	3604.6
P11	9761.1	3480.3
P12	9832.9	2414.7
P13	10957.2	2651.9
P14	11115.7	3800.7
P15	11689.0	2592.3
P16	11626.0	3406.8
P17	12333.7	2269.7

Table 2 : coordinates of the points surveyed by the police

4.2 Physical model

A non-distorted 1/400 scale model was built in our laboratory in 1964 and was calibrated against observations. At that time, the Strickler coefficient of the valley was estimated to be in the range 30-40. Fourteen gauges were put in the physical model, the first 5 being in the reservoir itself. The maximum free surface elevation at these gauges was measured. The measurements from these gauges are in a good agreement with the observed high water marks.

Table 3 gives the coordinates of the 8 gauges downstream the dam.

Gauge Number	Coordinates X (m)	Coordinates Y (m)
6	4947.4	4289.7
7	5717.30	4407.6
8	6775.1	3869.2
9	7128.2	3162.00
10	8585.3	3443.1
11	9675.	3085.9
12	10939.1	3044.8
13	11724.4	2810.4
14	12723.7	2485.1

Table 3 : Coordinates of the gauges

6 File descriptions :

The following file is provided:

MALP.GEO : ASCII file with " X Y Z " format containing the geometry