

## THE DAM OVER THE COUESNON



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*As a full-blown construction, the dam architecture fits in with all the dimensions of a site where nature, engineering and culture come together in an exceptional manner. It reconciles its proper setting within the broader scenery of the bay, combining its technical water management functions with its role as a public space for exploring and sightseeing.*

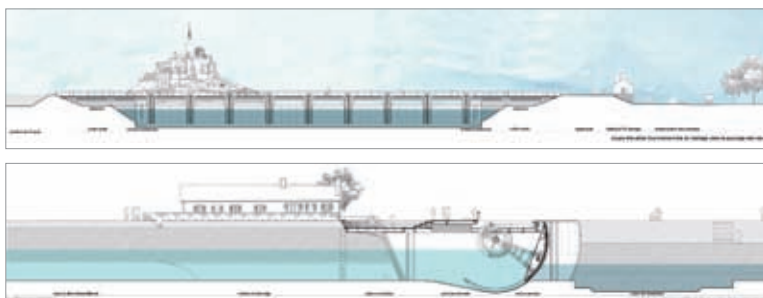
*As an integral part of the bay, clearly linked to Mont St-Michel, the dam is a feature of the profound cultural dimension that resonates with the spirit of the place and the collective imagination that goes with it.*

#### DESIGN PRINCIPLES: BETWEEN HYDRAULIC EQUIPMENT AND SIGHTSEEING AREAS

Above and beyond its main purpose controlling the water, the dam is designed in its every dimension to take into account and show off the site's outstanding quality.

In its hydraulic function, the project design is based on the "drum gate" or "sector gate" principle, where the geometry is deduced from water management constraints. For engineering and architectural reasons, the eight sets of sluice-gates on the upstream, Couesnon side of the dam free up the space facing out to sea towards Mont St-Michel, leaving a clear view of the landscape.

In its dissymmetry, in addition to the hydraulic equipment, the barrage offers new major public spaces over the water: facing the Mont, the promenade deck and marine balcony offer the public a unique standpoint from which to take in the view. The view opens up to Mont St-Michel, with all the variety of light effects and atmospheres, and the constant dynamics of the scenery and skies. To the south, on the land side, the channelled river can be seen and the mechanical efficiency of the equipment, producing a steady stream.



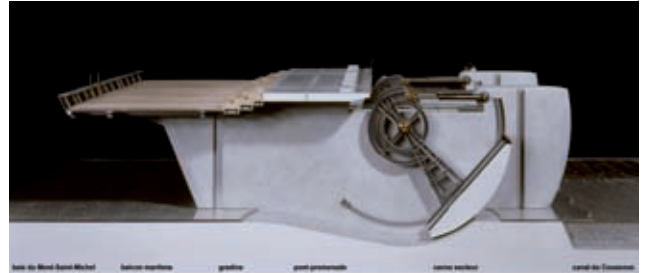
In this environment of churning water and energies, but also where people from all horizons can meet and explore a place steeped in history and culture, in the silence of the bay these spaces will encourage people to discover or rediscover how Mont St-Michel relates to nature, the water, the land, the sky.

Luc Weizmann, dam architect - [www.lwa.fr](http://www.lwa.fr)

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### THE ARCHITECTURAL DESIGN OF THE DAM

Each of the dam's components has been designed with formal reference to the site's marine character, in the detailed drawing of both the infrastructures and the superstructures; the architecture is seen as being indissociable from the functional reality of the works.



### THE HYDRAULIC EQUIPMENT

#### • The sector gates

The project design is based on the conventional "drum gate" or "sector gate" principle. Each of the eight gates is activated by two hydraulic cylinders.

Owing to its specificity and cyclical mobility, the single unit formed by the sector gate, its two arms and the two cylinders activating it is the project's original feature; it derives its special importance from being in all eight of the dam passes.

#### • The gate arms and wheels

The gate frame design refers back to the circular shapes of naval instruments such as sextants, with reference to the cyclical movement of the stars that governs the tides. The horizontal thrust of the cylinders activating the sluice-gates goes in the opposite direction to the movements of the seawater and river water.

The cylindrical unit formed by the sixteen wheels in the perspective of the dam is directly visible to the public from the promenade deck.

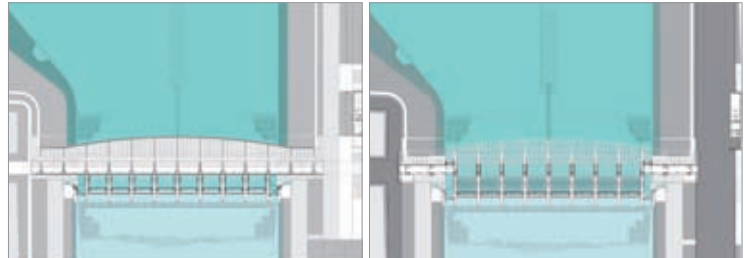


The gate rotation ensures filling by "overflow" (over the top of the gate) so as to limit the influx of sediment, and draining, through the gradual opening of an «underflow" (under the gate), and full hydraulic opening, depending on the play of the tides and the movement of water in the Couesnon.

The upstream plating (or facing) of the gates on the eight passes forms the structure's mobile unit. On the Couesnon side, it ensures the seal on the dam with the apron and piers. In stainless sheet steel, it guarantees the cohesion with the seal at the foot of the apron. On the sea side, the downstream frontage reveals the concavity and structure of the sluice-gate, notably when it is closed or in the underflow position.

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### THE SPACES OPEN TO THE PUBLIC



**The promenade deck is treated as an area to walk around, linking the two banks of the Couesnon, continuing on a level with the paths laid on along the east and west dykes.**

The high quality services derive from the architectural treatment: transparent guard rail on the land side, painted steel frame, bronze upper bulwark rail, windbreaker apron wall in screen-printed glass, deactivated concrete floor finish with the insertion of granite elements, following the dam grid.

### THE MARINE BALCONY

The marine balcony is designed like a suspended space projected out towards Mont St-Michel, on this symbolic dividing line between the bay and the inland, between the power of the elements and their control mechanism; the only place in the bay where you can stand over water even when the tide is in.

Apart from the passage, it is accessible via steps and terracing along its entire length. Opening up into an amphitheatre towards the bay scenery, it will be capable of hosting cultural events. Its hollow setting creating a feeling of coming close together, facing the landscape.

The marine balcony and its terraces are treated in rough oak planking, like a ship's deck. This is supported on large curved consoles anchored onto the dam piers.

### THE MARINE BALCONY BULWARK RAIL

The guard-rail on the marine balcony forms a kind of long table curved like a bulwark rail, up to a figurehead over the water, facing Mont St-Michel. This guard-rail-cum-windbreaker is also a support on which to lean as you look out, take photographs or write before the broad landscape of the bay; it is crowned by a linear bronze console divided up into moulded structural modules. A bronze pre-patina is done; the weather, rain and sea-mists will gradually look after giving the bronze texture its final tone, like the bell at the top of the Mont.

### THE LETTERED CONSOLE



**Engraved on the surface of the marine balcony console are the four alphabets on which the written history of Europe is founded, with Mont St-Michel still one of its living landmarks:** the Hebrew and Arabic alphabets, written from East to West; the Greek and Latin alphabets, from West to East. The perception of these different signs will be the subject of discovery, whether random or more systematic, to counterpoint the contemplation of the landscape and observation of the slow movement of the sluice-gates and the water.



**The night clock taken from a manuscript from Mont St-Michel indicates the North and the pole star. The coats of arms of Brittany and Normandy are engraved to the West and East of the Couesnon. Cockles and scallops are cast on the two ends of the console, as a tribute to the pilgrimages.**

## THE DAM OVER THE COUESNON

### TECHNICAL FEATURES

#### Dimensions

Overall length: .....	138.46 m (including abutments)
Minimum overall breadth: .....	15.6 m at right angles to the abutments (inc. marine balcony)
Maximum overall breadth: .....	32.4 m at the centre line (maximum span of the marine balcony)
Promenade deck: .....	138.5 m long; 6 m wide
Marine balcony: .....	900 m <sup>2</sup> curvilinear wooden planking; 320 m <sup>2</sup> of steps and terracing
Dam piers: .....	9 piers of variable dimensions (23 to 27m) 1.8 m wide.
Maximum dimensions of the concrete superstructures: .....	9.99 m IGN 69



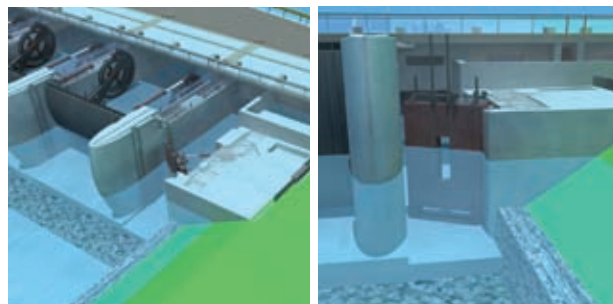
The dam piers, in smooth unfinished concrete, are dimensioned so as to preserve delicacy and elegance. On the Couesnon side, they form tapering prows where the upper section gathers the horizontal thrust stress from the cylinders. On the seaward side, they take up the metal consoles supporting the marine balcony.

From upstream, the dam abutments close off the scenery of the banks. The vertical wall is treated in horizontally grooved concrete; the play of light and shade produced by this relief fits in with the reading of the successive levels of the Couesnon. In the abutments are the hydraulic power plants, the electrical equipment and the fish lock mechanisms, so as to reduce the length of the networks and facilitate operation.

#### Hydraulics

The dam is made up of:

- 8 passes of 9 m hydraulic width
- 2 fish locks of 3.10 m hydraulic width each, located at either end of the dam
- Total overall hydraulics: 78,2 m
- 8 sector gates of approx. 67 m<sup>2</sup> surface area each
- Dam apron set on piers: width: 24 m, length: 99.6 m, thickness: 1.20 m



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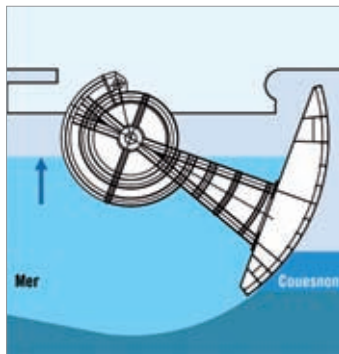
Two fish locks on the dam's East and West banks enable migratory fish to come up from the bay into the Couesnon to the upstream side. They each comprise: downstream, two fixed wheel type lift gates; upstream, a conventional sluice-gate fitted with a paddle valve. The play of alternately opening and shutting these devices, depending on the water level in the sea and the Couesnon, helps the fish through.

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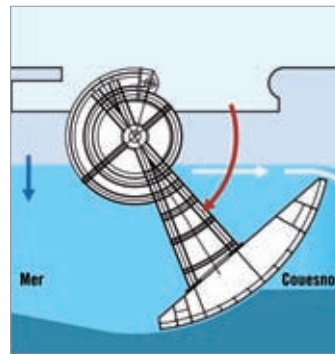


### TECHNICAL DATA POINTS

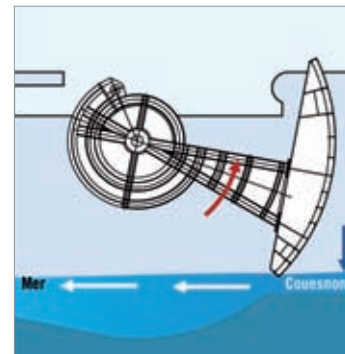
The hydraulic efficiency of the fillings and drainings depend on the combined flow rate of the River Couesnon and the water level (tidal coefficient). The simulation illustrates a selected average situation. The tidal coefficients required to meet the targeted volumes vary within the range of 50 to 120. During wet spells, the River Couesnon input varies from 67% for the lowest flushing volumes (800,000 m<sup>3</sup>) to 38% for the highest volumes (1,400,000 m<sup>3</sup>) with an average 50% for the intermediate volumes (1,100,000 m<sup>3</sup>). Conversely, in August, these same amounts account for no more than 5 to 9% of the volume.



**STAGE 1**  
The tide comes in. The gates are closed.



**STAGE 2**  
The River Couesnon fills up: water flows over the top of the gates to limit sediment getting in (overflow).



**STAGE 3**  
The gradual opening of the gates underneath (underflow) allows for controlled releases of water to extend the effects of the ebb tide.



Overflow filling



The gates closing...



High tide slack water

#### Dam operating principle

- Gates close: High tide - 1hr30'
- Start of overflow filling: High tide - 10'
- Maximum allowed level in the upstream Couesnon: 6 m IGN 69
- Maximum volume stored in the Couesnon: 1,400,000 m<sup>3</sup>
- Start of the release of water: High tide + 6h
- Duration of the release of water: between 2 and 5 hours depending on stored volumes
- Maximum released water flow rate: 100m<sup>3</sup> / s (i.e. 2m / second)

## THE DAM OVER THE COUESNON

### DAM DESIGN & CONSTRUCTION – THOSE INVOLVED



• OWNER  
Syndicat Mixte Baie du Mont-Saint-Michel

• OPERATION SUPERINTENDENT  
Mission Mont-Saint-Michel,  
DDTM de la Manche

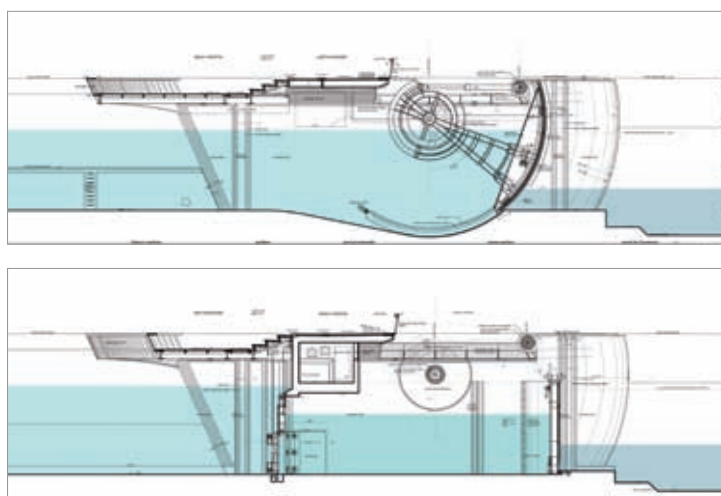
• PROJECT ARCHITECT GROUPING

- BRLi / Civil engineering / hydraulics design agency
- Luc Weizmann / Architect
- Spretec / Equipment-structure research agency
- Antea / Bureau d'études environnement
- Bertrand Lanctuit / Paysagiste

• CONTRACTORS

- Earth moving / Civil Engineering contract: Quille / Mastellotto
- Equipment contract: CM Paimboeuf / Joseph Paris / Baudin-Chateauneuf
- Superstructure contract: CM Paimboeuf / Joseph Paris / Baudin-Chateauneuf
- Dam management building: Chauvin / Lavigne / Baudin / Leblois / BLO / UIN / ELYTA / Lepasant grouping
- Bronze work: Fonderies Vincent
- Wooden planking: Aubert-Labansat

All the dam contractors:  
[www.projetmontsaintmichel.fr](http://www.projetmontsaintmichel.fr) > Rubrique Chantier barrage



Photography credits / illustrations: Luc Weizmann Architect / Catherine Claden Maquettiste / Nicolas Borel, Daniel Fondimare and Thomas Jouanneau, photographers

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