



**Environmental  
Hydraulics  
Group**

**Hydraulic Transients (HT)  
- Power & Co-Generation**

**Project: Penstock Rupture at Lock 7,  
Welland Canal – Event Investigation**

**1991-401**

**Location: Welland, Ontario**

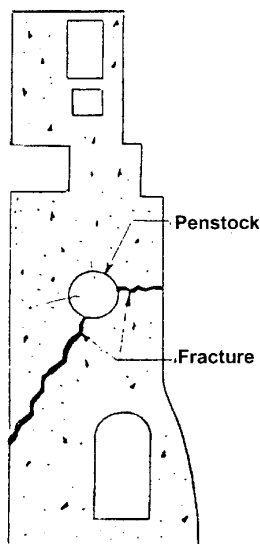
**Client: Fasken Campbell Godfrey, Barristers and  
Solicitors**

**Completed: September 1991**

**Description:** In October 1985, a sudden rupture occurred in the west wall of the Welland Canal's Lock No. 7. EHG was authorized by Fasken to undertake an investigation concerning hydraulic transients within the penstock encased inside the reinforced concrete canal wall. The penstock is 2 km in length and 2600 mm in diameter. A number of findings resulted from EHG's preliminary investigations:

- i) Two diagonal cracks extended from the penstock to both sides of the canal, causing a 70 m long section of the penstock and canal wall to fracture (see photo and section below).
- ii) The fracture area was located at the most upstream part of the penstock where the pressure should be the least during a steady state and normal surge condition (see profile at bottom of page).
- iii) The large mass of water (over 10,000 m<sup>3</sup>) and high flow velocity (3 m/s) resulted in the potential for very large transient forces to be exerted on the penstock wall and concrete encasement.
- iv) Air entrainment was reported at the entrance to the penstock. This air could accumulate at locations where the penstock's slope changes sharply – such as at the observed failure point (see profile).
- v) Water leakage had occurred from the penstock in the vicinity of Lock 7. Since air pockets could escape through small openings much more quickly than water, there was a potential for high surge pressures upon water columns rejoining after the air pocket has been rapidly expelled (or collapsed).

**Benefit to the Client:** The above findings obtained during the preliminary investigation assisted the negotiation to defer the legal case. A better understanding of the physics of the failure aided such discussions.



—SECTION—

