Arch Structures

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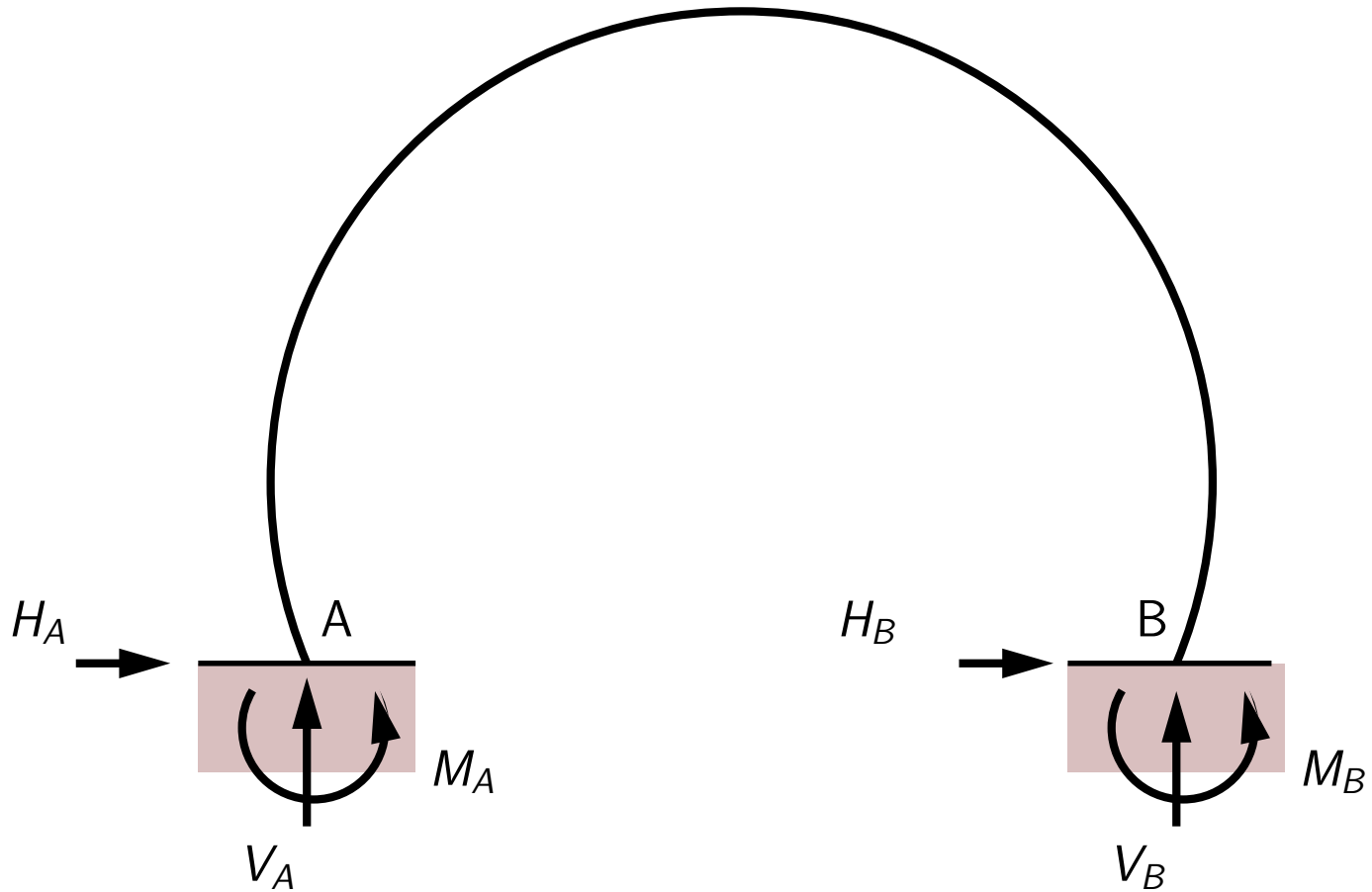
Overview

Types of Arch Structure

Fully-Fixed Arch

Analysis: Statically indeterminate: $\widehat{i} = 3$.

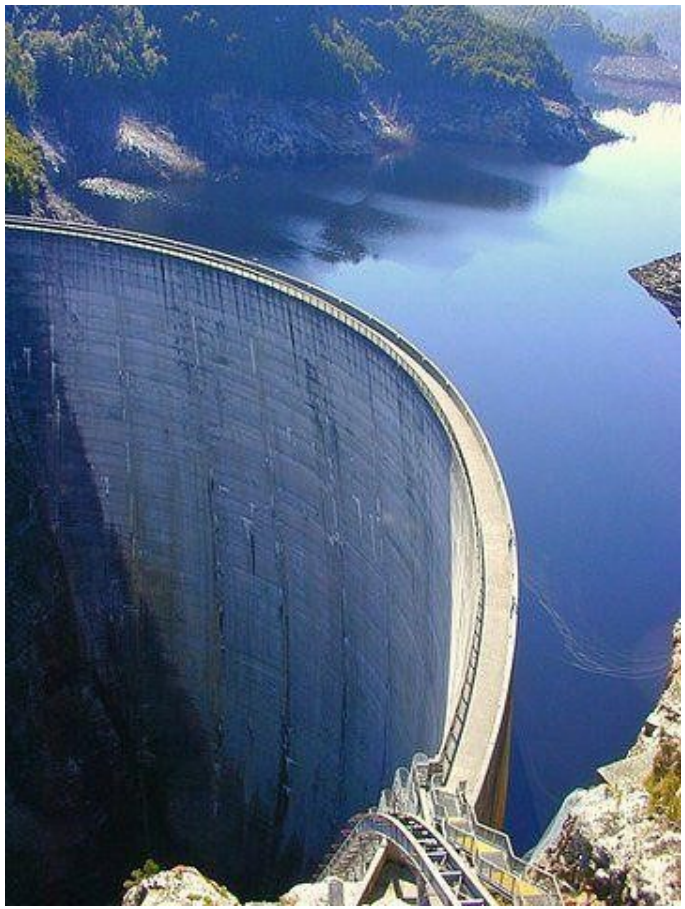


Fully-Fixed Arch

Arch Dam: Uses arching principle to resist water pressure.

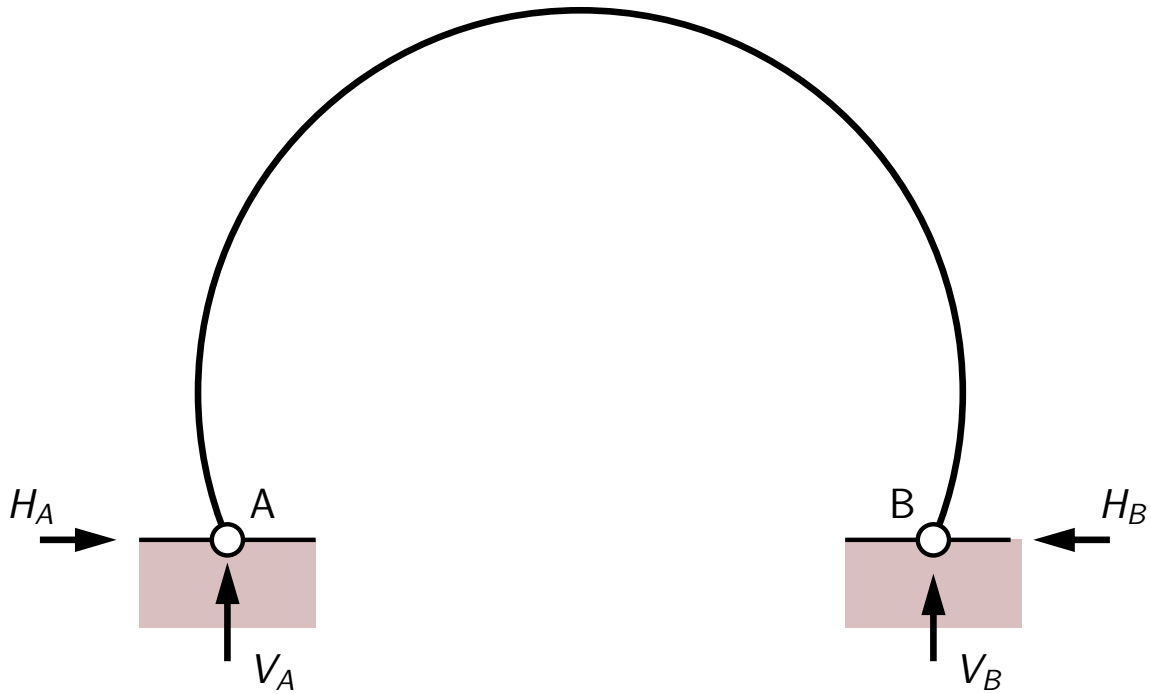
The main loads are:

- Dead load.
- Hydrostatic load generated by upstream reservoir.
- Temperature and earthquake loads.



Two-Hinged Arch

Analysis: Statically indeterminate: $\widehat{i} = 1$.



Support Hinge:

- Prevents transfer of moment into foundation.
- Free to rotate – this is important for thermal expansion.

Two-Pinned Arch

Sydney Harbour Bridge: Arch-based steel frame, construction 1923-1932.

Bridge System: Rail, vehicular, bicycle and pedestrian traffic.

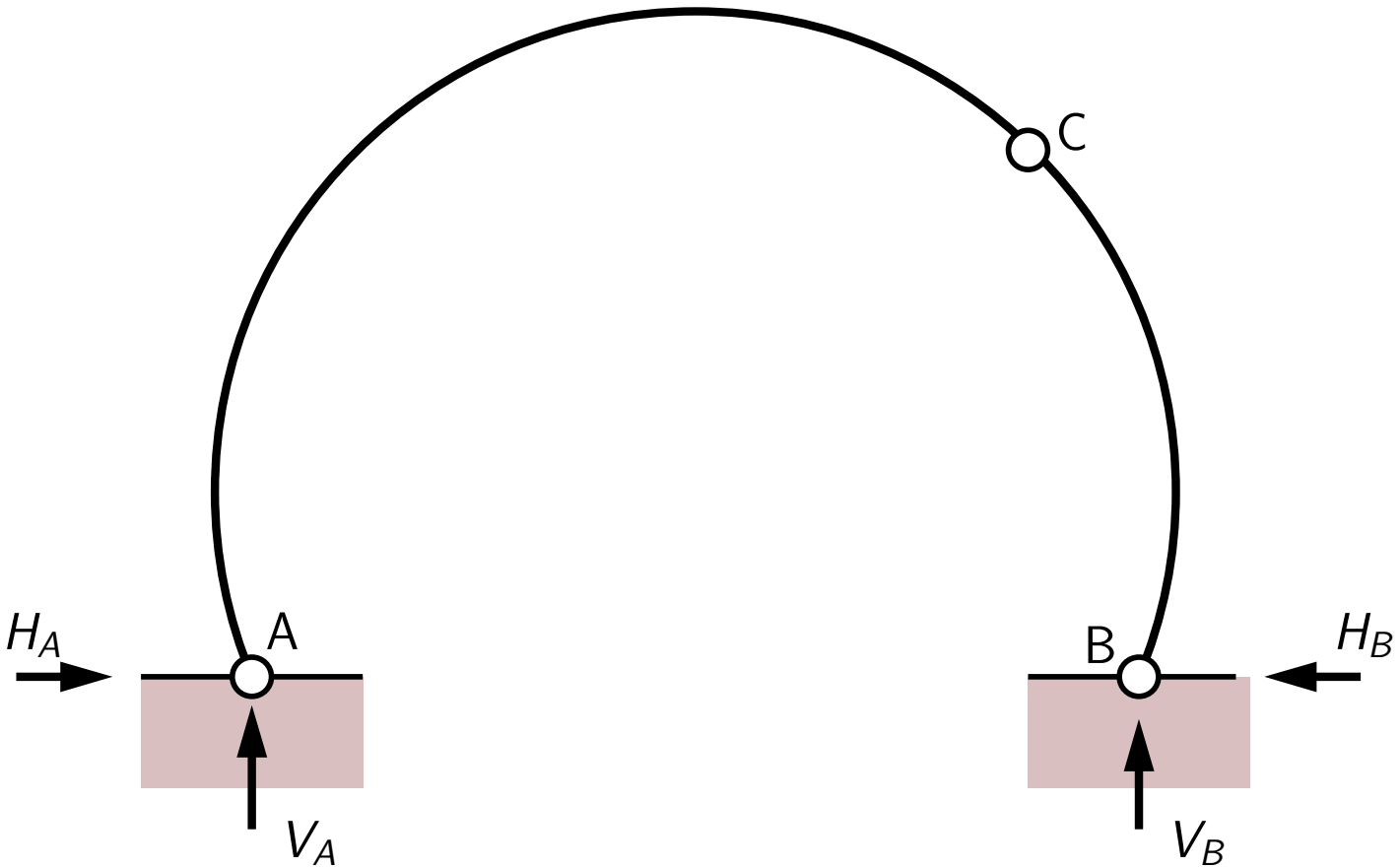
Two-Pinned Arch

Pin Supports in Sydney Harbour Bridge:

Key Advantages: Hinge provides built-in support for thermal expansion.

Three-Pinned Arch

Analysis: Statically determinate: $\widehat{i} = 0$.



Three-Pinned Arch

Basic Questions:

- What are the support reactions?
- What are the forces transfered acro the internal hinges?
- What do M(x), V(x) and N(x) look like?
- Does the relationship $V(x) = \frac{dM}{dx}$ still work?

Harder Questions:

- Does the position of the internal hinge matter?
- What is the optimal shape for the arch?