



## Bridge over Jökulsá á Fjöllum – when is a glacial flood too large to design for?

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### Abstract

Volcanic eruptions can result in lava flows, ash fall or when an eruption is under the glacier, large glacial water outburst floods, or jökulhlaup, which can have catastrophic effects. Recent jökulhlaups in Iceland have resulted in the collapse of a few bridges. The existing bridge over Jökulsá á Fjöllum on the Icelandic Ring Road (road no.1) is a suspension bridge with a main span of 107 m, built in 1947, and with a limited capacity for heavy transport. In 2014, a new bridge was being planned and almost ready for tender. However in August 2014 a volcanic eruption started 10 km north of Vatnajökull glacier. There was a considerable likelihood that the eruption would extend under the glacier. Decision was made to change from the previously designed alternative to a cable stayed bridge which provides an alternative flood path, being more robust to an extreme event and much increased flow capacity.

**Keywords:** extreme events, scour, reliability, earthquakes, Eurocodes

### 1 Introduction

Iceland is located in the active Mid-Atlantic Ridge Volcanic Zone (NVZ). Earthquakes and volcanic eruptions are therefore relatively frequent events. Volcanic eruptions can result in lava flows, ash fall or when an eruption is under the glacier, large glacial water outburst floods, or jökulhlaup, which can have catastrophic effects.

Recent jökulhlaups in Iceland have resulted in the collapse of a few bridges. A large jökulhlaup in Skeiðarársandur in 1996 resulted in the collapse of 2 bridges, estimated peak flow was 40.000-50.000 m<sup>3</sup>/s. In 2011 a 130 m long bridge in Múlakvísl river was washed away after a flood from the Mýrdalsjökull glacier.

Jökulsá á Fjöllum is a glacial river originating in the North part of Vatnajökull glacier, the largest glacier in Europe.

The existing bridge over Jökulsá on the Icelandic Ring Road (road no.1) is a suspension bridge with a main span of 107 m, built in 1947, and with a

limited capacity for heavy transport. In 2014, a new bridge was being planned with a final design for a 230 m long post-tensioned concrete bridge in 5 spans, almost ready for tender, with construction planned for 2015. However in August 2014 a volcanic eruption started 10 km north of Vatnajökull and continued until February 2015, with new lava fields larger than 80 km<sup>2</sup>. There was a considerable likelihood that the eruption would extend under the glacier which could result in a glacial flood. This changed the area from being inactive for more than 200 years, to be an active area with an increased likelihood of further volcanic events.

There is a history of glacial floods in the water basin of Jökulsá á Fjöllum, it is believed at least 9 different eruptions under the glacier occurred in the years 1490-1776.

Historically many jökulhlaups have been traced in the Jökulsá á Fjöllum catchment, including some of the largest prehistoric floods, that have recreated the landscape after last glacial period