Dam Accident Data Base DADB - The Web Based Data Collection of ICOLD

J-J. FRY, EDF CIH, Le Bourget du Lac, France
A. VOGEL, Risk Assessment International, Vienna, Austria
J-R. COURIVAUD, EDF LNHE, Chatou, France
J-P. BLAIS, EDF CIH, Le Bourget du Lac, France

SYNOPSIS
This paper describes a database (DADB) that includes all information about dam failures which are necessary for the evaluation and the assessment of failure modes and hazards. The DADB currently includes about 900 events, all individually observed and investigated.

INTRODUCTION

Risk estimations associated with dam failures based on statistical studies had been difficult to carry out, because either the information of different data base were contradictory or no data were available. The comparison of different failure rates also faces difficulties, because some failure listings define "failure" as an accident that destroys a dam and renders it useless, while others mean a catastrophic accident, which releases most or all of the impounded water. In 1974 ICOLD published a first failure list, which presented 202 dam failures [2]. 5 years later the results of another investigation showed only 129 dam failures [3].

In 1995 ICOLD updated this compendium [4] by defining a failure as a collapse or movement of a part of a dam or its foundations so that the dam cannot retain the stored water. Accidents during construction were considered to be failures when a large amount of water was released downstream by a river flood which caused the partial or total destruction of the dam, whereby the height of the dam in construction when the overtopping began should have a height of at least 15m or reservoir filling had commenced before dam completion. According to these definitions 179 failure cases were determined, which all concerned large dams, according to ICOLD's definition from 1973 [1].

Long-term benefits and performance of dams. Thomas Telford, London, 2004

Therefore no catastrophic failures of dams during construction are considered, as long as the reservoir was empty and also no large slope stability failures during construction, which often led to critical situations for the workers. Not only reservoirs, which impound water, but also tailings dams, impounding tailings or toxic fluids have caused extensive damage in previous failures. The failures of the tailings dams of Buffalo Creek in 1972 caused 125 deaths and in 1985 in the Stava valley, Italy, 268 people died after a similar catastrophe, not to mention the contamination after the failure of the uranium tailings dam Key Lake in Canada in 1984 or the recent release of 100,000m^3 of contaminated cyanide liquid after the failure of a tailings dam in Romania in January 2000 and the subsequent poisoning of drinking water of more than 2 million people in Hungary.

ICOLD recognized the need for a compendium on failure data of such constructions and published for the first time in 2001 a bulletin concerning failure events of tailings dams [5].

Failure causes must be investigated irrespective of the dimensions of a dam or the extent of its hazard. The failure in 1972 of the Canyon Lake dam in the USA, which was only 6 m high, caused the death of 300 persons [6]. Data on failures of small dams include valuable contributions for the assessment of failure modes and causes, as well as for those of large dams [7]. The proposed DADB will be web based and include data on failures of small and large dams as well as failures of tailings dams (Figure 1).

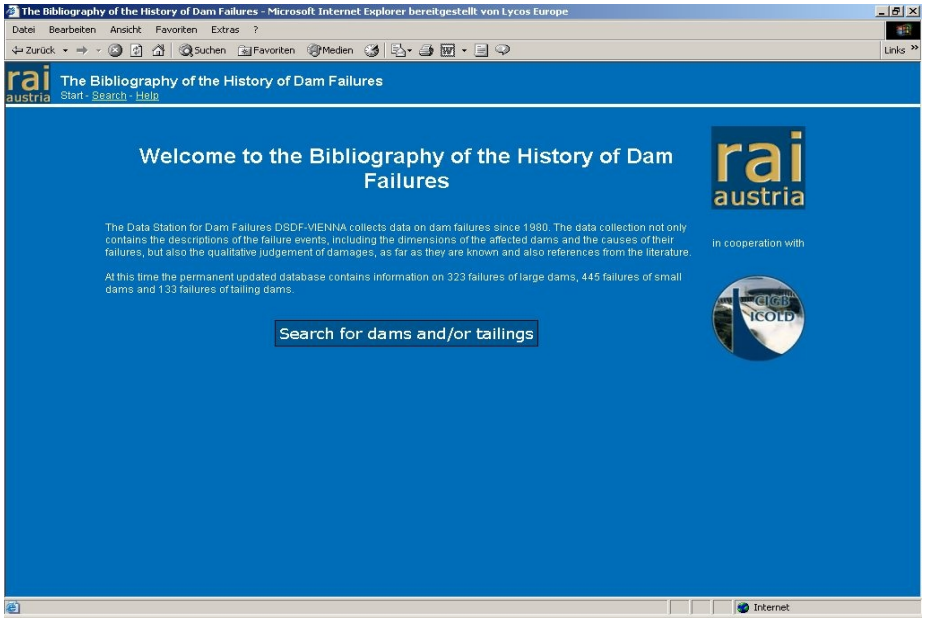

Figure 1: Front page of DADB

CONTENTS OF DADB

Dam information

The opponents of statistical studies based on historical records of dam failures criticise the fact that data of the past would be not homogeneous and therefore the dam failure information not directly comparable. The proposed DADB sweeps away these arguments and offers information about the name of the dam, the country, the date of its construction its purpose, the date of failure, the type of the dam, its height (above ground level and lowest foundation), crest length, crest width, base width, volume, upstream and downstream slope geometry. The type of material (watertightness, upstream shoulder, downstream shoulder, downstream protection), type of spillway (type, width, height, design flood), information about foundation (type, thickness) and reservoir (capacity, normal water level, maximum water level) will also be given. In cases of tailings dams the kind of impoundment is also available.

DADB will relate the failures exactly to all known current dam types. It was therefore necessary to distinguish between 20 different types of dams for water storage and 7 other special kinds of types of tailings dams, according to international regulations and their particular methods of construction.

DADB also provides the user with 7 different uses of the failed dams, which are the storage of tailings, for hydroelectric, flood control, irrigation, water supply, for wood transport or unknown purposes (Figure 2).

Failure information

To avoid probabilistic techniques to estimate dam failure risks and structural reliabilities it was stated that dams can fail through an infinite number of modes, which cannot be fully enumerated [8]. DADB contains the primary failure causes, which were investigated after the dam failures. 13 different failure causes, including the sensitive ones caused by construction or calculation errors or hostile failures are distinguishable (Figure 2).

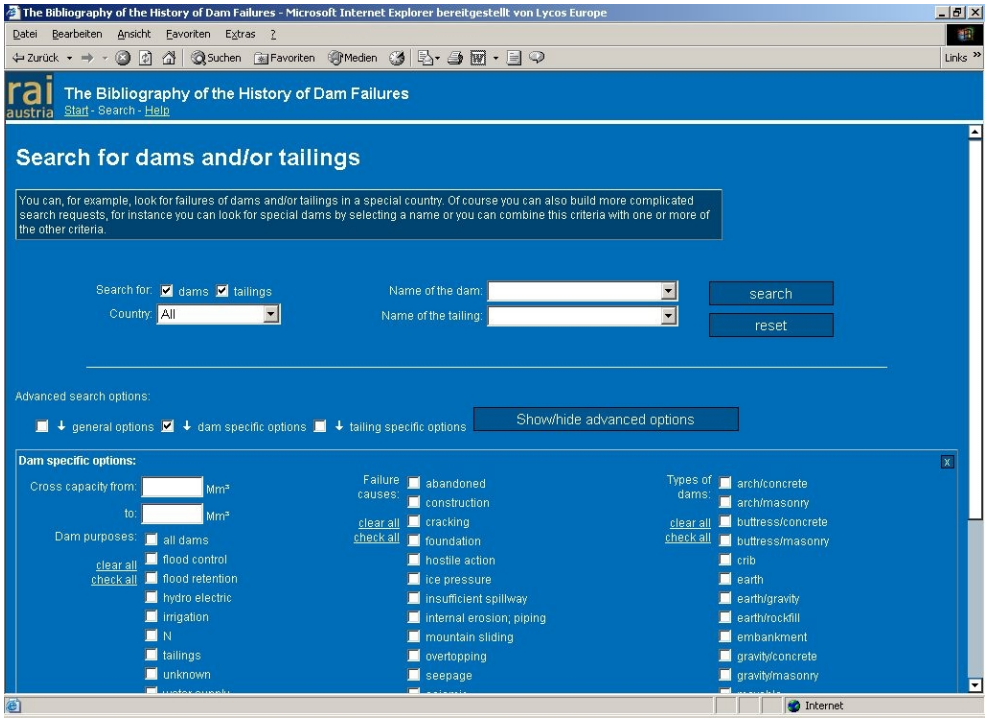

Figure 2: Advanced search page of DADB

The database will include (if known):

- information about breach initiation
- maximum depth above breach
- volume stored above breach invert
- evolution in time of overtopping
- breach height
- breach top width
- breach bottom width
- breach average width
- breach side slope
- breach and empty time
- breach peak outflow
- breach outflow hydrograph
- method of determining peak outflow
- flood peak entering in the reservoir
- flood hydrograph entering in the reservoir
- eroded volume
- outflow volume

Supplementary information

DADB also gives information about the human and the economic damage caused by a dam failure, as far as it was reported. In cases of tailings dam failures the volume of the outflowed tailings or contents and the travel distance is additionally available. Pictures of some events are also available, which show the dimensions of the damage to the dam construction. The pictures of the photo gallery can be enlarged to full size. (Figure 3).

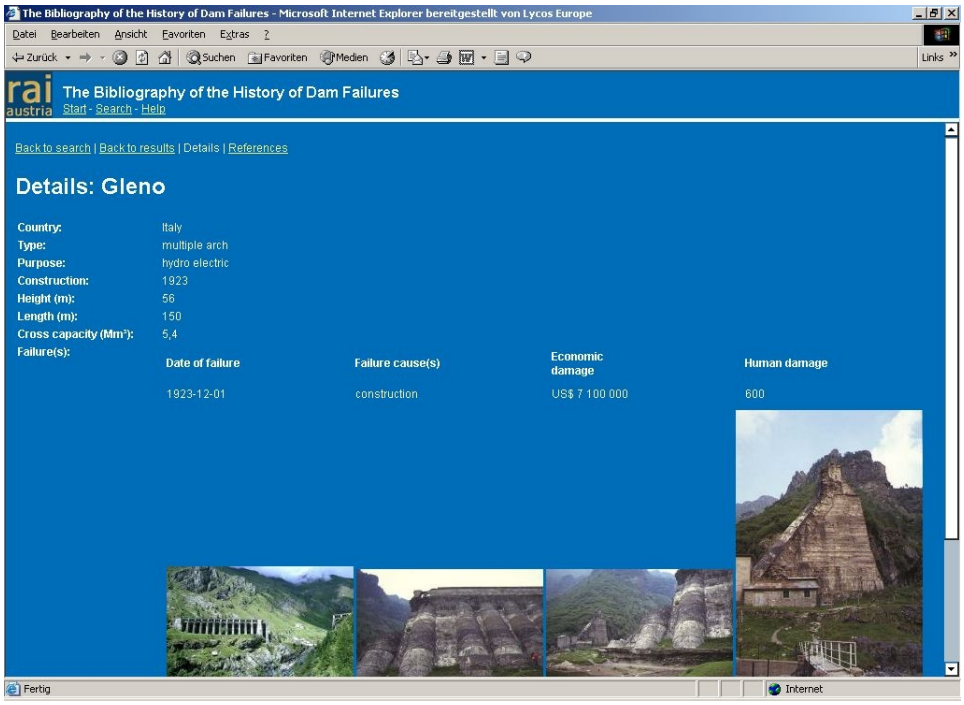

Figure 3: Example of a result page of DADB

Reference information

To verify the origin of the data, a list of references is included for each dam failure, to enable the user to get additional information to that presented on every result page (Figure 4). Most of the references will be also available in form of pdf - files

SEARCH OPPORTUNITIES

On the search page (Figure 2) it is possible to search for every single parameter which is mentioned, but also for all in every combination. The search for height, length and for the storage capacity or for the impoundment is possible for a special rate or in intervals. A click to one of the names of the dams in the summit list of every search operation leads the

user back to the failure sheet for this dam, to provide him with the accompanying references, the photos and all the other parameters.

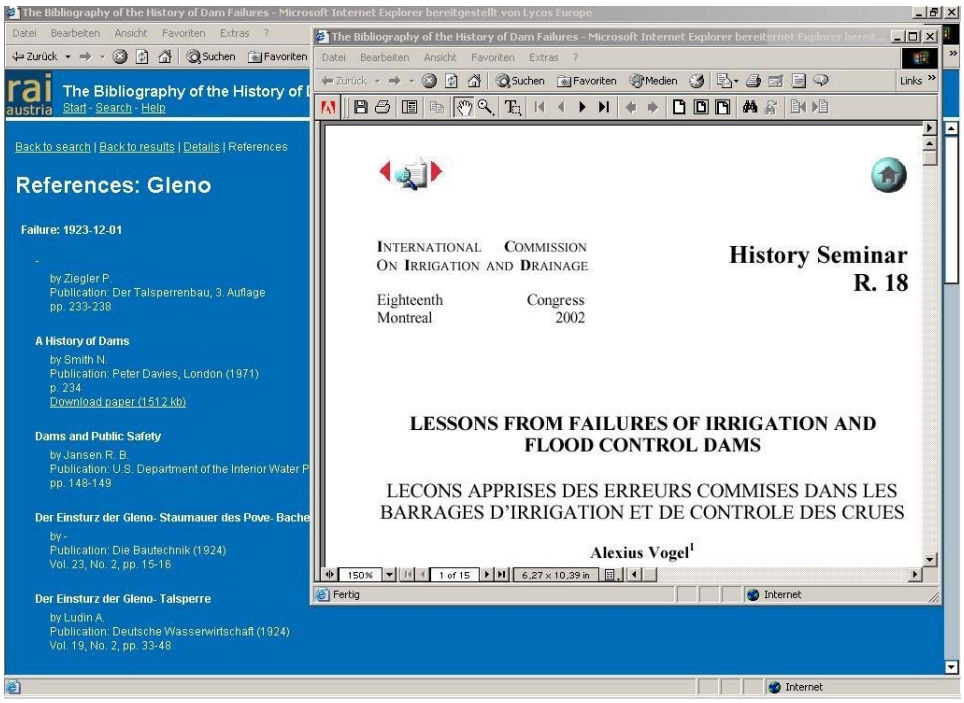

Figure 4: Example of a reference page of DADB

RESULTS

The number of all reservoirs impounding water, which are a standing menace to life and property will be today in the order of 400,000. DADB documents now more than 900 dam failures and 132 of those of tailings dams and will be updated permanent.

CONCLUSION

DADB includes all information about failures of water storage and tailings dams which are necessary for the evaluation and the assessment of failure modes and hazards. Today it includes about 900 events, all individually observed and investigated. The data are also usable for the assessment of failure behaviours and for the investigation of a probable existing failure-cause-specific break-mechanism.

REFERENCES

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