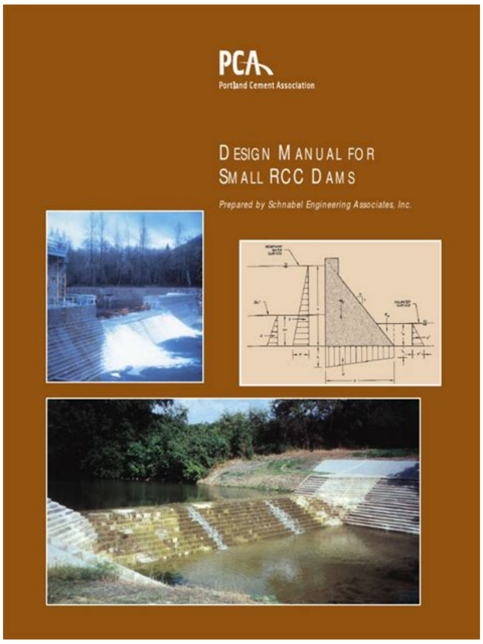
Dams Design Manual



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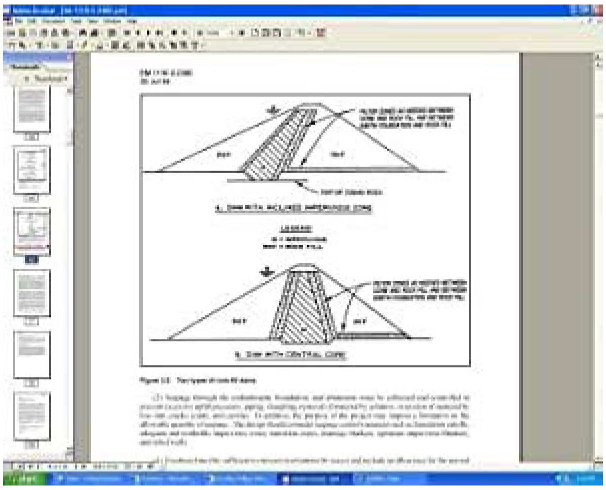

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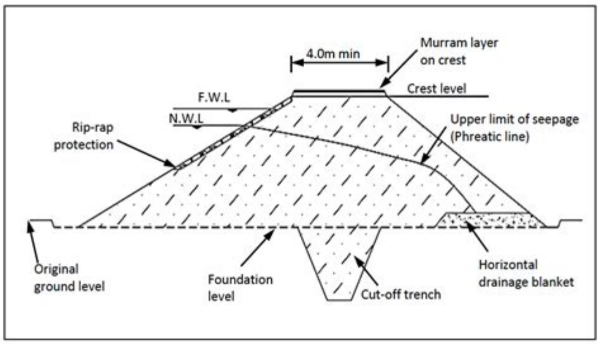
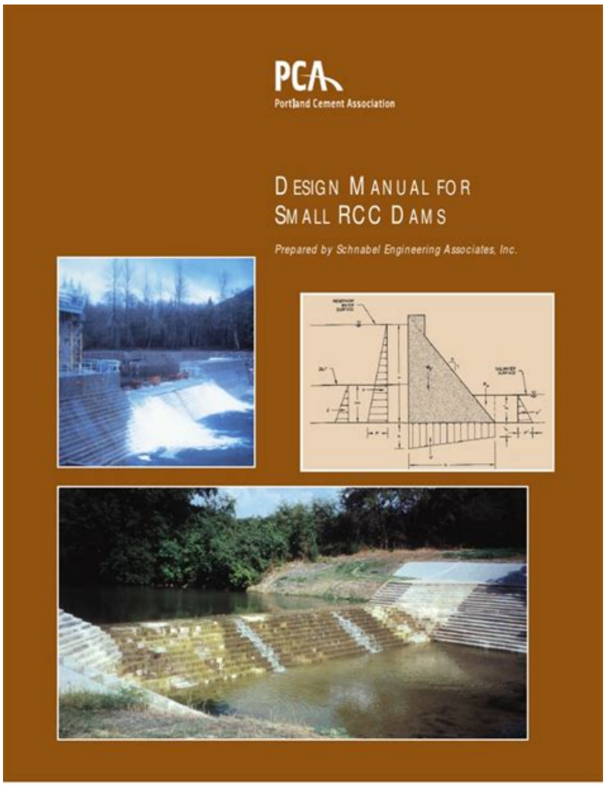
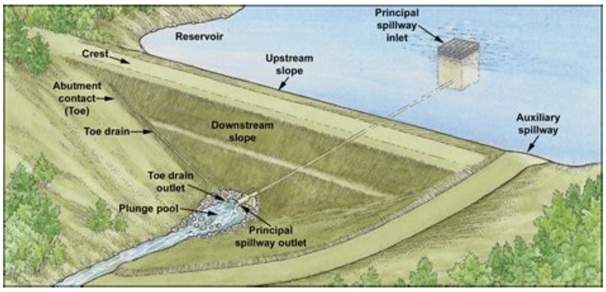


The height of a dam, its maximum impoundment capacity, the physical characteristics of the dam site and the location of downstream facilities should be assessed to determine the appropriate hazard classification. DEC recommends that critical data, including dam location and hazard classification, be verified in the field. The presence or absence of a dam in this inventory does not indicate its regulatory status. Any corrections to the inventory should be submitted to the Departments Dam Safety Section with supporting information. For more information, go to FEMA's library by clicking the button below. Their guide builds on Comprehensive Preparedness Guide CPG 101 Developing and Maintaining Emergency Operations Plans.1 It also provides guidance for dam owners and operators on how to engage with emergency managers prior to an incident to ensure a wellcoordinated response. Appendix A provides a general template for a community dam incident plan that can be adapted to meet each community's needs. All charts, queries and maps reflect the most current NID database. The NID was populated using the 116th Congressional District information. State and federal dam regulators provided their data from May to November 2018 for inclusion in the 2018 database. Please be aware that inspection and EAP dates reflect 2018 data, so any inspections or updates since then will not be reflected in the current NID. Please contact the respective state or federal regulatory authority for the most uptodate information. Major changes to the 2018 NID allow users to download or export certain NID data and to view the hazard potential classification. State or federal agencies may restrict access to information on dams within their jurisdiction, in some cases. For information not published in the NID, USACE recommends consulting the agency exercising responsibility over the dam.http://asipac.com/userfiles/car-stuck-in-reverse-gear-manual.xml



Also, it is important to note the hazard potential classification, as published in the NID, does not reflect the condition of a dam. That information can be found in the condition assessment, which is available to approved government users. Workshop topics include Decommissioning, Construction, Monitoring and Levees. Presents instructions, procedures, and standards for use in the design of concrete gravity dams. It serves as a guide to sound engineering practices in the design of concrete gravity dams and provides the technically trained, qualified design engineer with specialized and technical information that can be readily used in the design of such a dam. NOTE NO FURTHER DISCOUNTS FOR ALREADY REDUCED SALE ITEMS. Other related products Safety Evaluation of Existing Dams A Manual for the Safety Evaluation of Embankment and Concrete Dams can be found here Dams and Public Safety can be found here Design of Small Dams can be found here Dams and Control Works can be found here Concrete Dam Instrumentation Manual can be found here Dams, Dynamos and Development can be found here Ground Water Manual A Guide for the Investigation, Development, and Management of GroundWater Resources can be found here Taking Stock of Your Water System A Simple Asset Inventory for Very Small Drinking Water Systems can be found here See Details. Of the recipes shown here, most are open source so you can use them for your purposes in your own designs, permit applications and reports. Like most recipes, local adaptations, substitutions and changes can be made to best suit your needs. However, when getting started, or for defining minimum standards of practice, the receipes are helpful. We license all these with a creative commons attribution license so you can adapt for your own purposes and, distribute and shareNew York New Jersey Trail Conference, Mahwah, NJ, pp. 24. Island Press, Washington D.C., 256 pp.

Functions of the dam safety program include conducting dam inspections, maintaining an inventory of dams in North Dakota, determining the hazard classification of dams, and assisting with emergency preparedness activities. Dam safety program staff inspects nonfederally owned high hazard and medium hazard dams on a rotational basis. Additional inspections are conducted following the spring runoff, on request from dam owners, or when there are concerns at a dam, such as during flood events. Funding to assist with dam safety repairs may be available through the State Water Commission’s costshare program, or through other funding sources. An EAP is a formal document that identifies potential emergency situations that could occur at a dam and specifies the course of action to be taken when an emergency situation arises. The purpose of an EAP is to minimize loss of life and property damage. The State Water Commission has developed an EAP guidance document to provide additional guidance for developing, testing, and updating EAPs in order to comply with N.D.C.C. Section 610325. A recommended EAP template, developed by the Natural Resources Conservation Service is also available. Additional general guidance on developing an EAP is available in the document “Federal Guidelines for Dam Safety Emergency Action Planning for Dams” link below. Funding to assist with developing an EAP may be available through the State Water Commission’s CostShare Program. These classifications are defined in North Dakota Administrative Code 89080101. The hazard classification is determined when an applicant applies for a construction permit for a dam. The hazard classification of a dam can also change over time due to changes in development downstream of the dam. These low head dams can create dangerous conditions that recreational river users may not be aware of or may underestimate.



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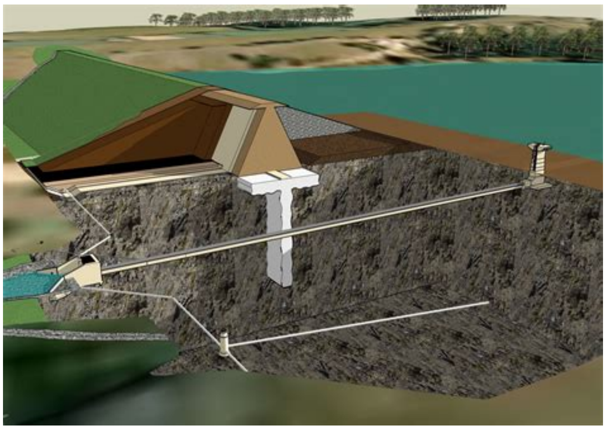
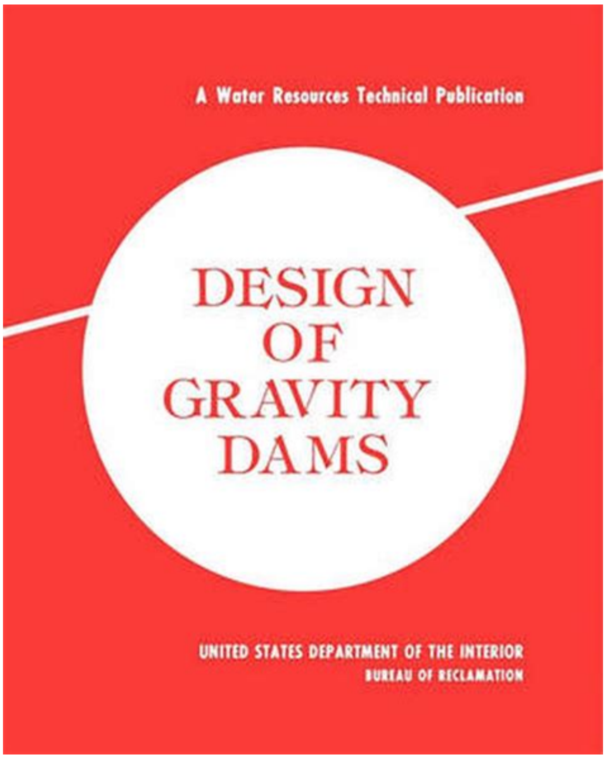
Under the right conditions, water flowing over the dam can cause a “roller effect” on the downstream side of the dam. Strong recirculating currents can trap and drown boaters, swimmers, or other water users. More information regarding safety at dams is available at the Association of State Dam Safety Officials. We will provide up to two signs per dam, free of charge. However, installation efforts will be a local responsibility. For more information on these free dam safety signs, please call 701 3282760 or email. Excavated tanks for rainfall storage are common in the southern agricultural areas of Western Australia. Poor design and construction can lead to excessive costs, downstream erosion and risks to property and people. Dams block an existing waterway, and earth tanks are an excavation into which water is diverted. This page only deals with excavated tanks, which can be hillside dams, excavated earth tanks, ring or turkey nest tanks. An excavated tank is an earth structure on nearlevel land used to store water, in which part of the storage capacity is below ground level. On sloping land, the tank is often called a hillside dam or just a farm dam. The following guidelines are for rectangular, square and circular excavated tanks that do not require a civil engineer. Why use hillside dams Hillside dams are a costefficient way of collecting and storing runoff water from winter rainfall where there is no easily accessible and suitable groundwater for pumping. Also, hillside dams avoid shallow saline watertables in the valley floors. Many of the soils in the southwest agricultural areas have sufficient clay content to provide a good seal. A disadvantage of hillside dams is that they have relatively large surface areas for the dam volume, and net evaporation rates in the dry summer are often greater than 1500mm.



Recommended good practice Depending on the type of excavated tank choose the right design and construction for the site see below test and use clay soils that will seal the dam use improved catchments roaded catchments use silt traps and pipe inlets use designed spillways for the silt trap and tank fence the roaded catchment, silt trap and tank to exclude livestock pump and reticulate from the tank to storage or watering points. How hillside dams are used Hillside dams are used where filling is from a natural or improved catchment grade banks or roaded catchment where the front wall upslope of the structure is open or continuous with piped inlets for supplying single paddocks or droughtproofing whole farms for livestock water supplies for crop spraying water for domestic use onfarm for firefighting water supplies for aquaculture. Back to top How hillside dams work Hillside dams are most effective at holding water when the base and inside walls of the dam are sealed with clay of low permeability to minimise leakage, and when catchments are improved to increase and collect runoff. In many agricultural areas of Western Australia WA, runoff from crop land and pasture is not adequate to reliably fill farm dams. Runoff can be improved by using grade banks and roaded catchments Figure 1. Figure 1 Side roads or grade banks increasing water harvesting into a farm dam Conditions where these guidelines apply on gently to moderately sloping land, for excavated tanks and hillside dams in agricultural and pastoral areas anywhere there is a requirement for initial or additional water supplies near to, but clear of, streams, creeks and rivers; positioned so that the overflow from the structure can be safely diverted to a stream, creek or river where a natural or improved roaded catchment is of sufficient area to fill the farm dam.



Types of dams Rectangular or square excavated tanks with three or four walls These are the most common type of farm dams in the agricultural areas of WA. Excavated tanks need to be constructed of clay or have a clay lining that is 0.7 to 1.0m thick. A 3walled excavated tank is open at ground level on the uphill, and the excavated soil is used to construct the 3 walls above ground with freeboard above the full supply level. Fourwalled and round excavated tanks optimise capacity and minimise siltation. Double dams Double dams Figure 2 are useful where watertables limit depth of a dam. The design reduces the loss of water to evaporation by having smaller and deeper excavations to limit the surface area relative to the volume. Evaporation reduction is particularly effective when the smaller dam is kept topped up by pumping from the larger dam. Figure 2 A double dam design showing water movement between dams Ring and turkey nest tanks Ring and turkey nest tanks Figures 3 and 4 are used on flatter sites where shallow saline watertables may be present. The base of the dam can be near ground level. Ring tank Figure 4 walls are usually constructed from earth borrowed from a ring inside the tank, with a centre island at normal ground level. This type of tank is prone to leakage there can be low levels of clay in the excavated soil and high evaporation loss relative to hillside excavated tanks the surface area relative to water volume is high. Figure 3 A circular excavated tank with guiding wing banks and a silt trap. Turkey nest dams consist of a completely enclosed earth embankment, which is filled by pumping from an alternative water source i.e. a creek, groundwater or other smaller dams. These dams are usually sited as high as possible in the landscape so that water can be reticulated from them to other parts of the property. The dams built in WA do not usually retain a mound of soil in the centre and are smaller than those in New South Wales and Queensland.

Turkey nest dams require a site that is reasonably flat with good dam building clay not more than a metre below the surface; otherwise, the cost of overburden removal reduces the cost effectiveness of construction. Turkey nest tank walls are constructed mostly from earth borrowed from outside the tank. The tank in Figure 4 has used this excavated area as a catchment, and the centre of the tank has been excavated to some degree. The milky blue colour is caused by suspended clay in the very fresh water. Water from this tank is pumped and reticulated to other parts of the property near Esperance. Figure 4 A turkey nest tank excavated on level ground over a saline watertable. As the saucer catchment fills, water enters the tank through a piped inlet. The piped inlet can be closed on the outside, and fresh water pumped into the tank, allowing the water level in the tank to be higher than the surrounding land. Back to top Planning considerations The Occupational Safety and Health Act 1984 sets objectives to promote and improve occupational safety and health standards. The Act sets out broad duties and is supported by more detailed requirements in the Occupational Safety and Health Regulations 1996. Local government may have limitations on dam placement, especially in relation to roads and other infrastructure. For example, dams are not to be sited within 100m of a watercourse or within 200m of roads. Excavation site should be drilled, or test pits dug, to 1m below the proposed maximum depth of the excavation. Take soil samples and note the presence of subsurface water, rock and gravel or sand seams. Soil types at the construction site are fieldtested and classified to ensure the stability of the proposed structure. Soil is field classified for engineering properties using the Unified Soil Classification System. Test with particular attention to dispersion, aggregation, cracking and grading. Clay content is to be at least 25%.

Structure capacity is determined by assessing water requirements and catchment yield with consideration of evaporation and seepage. Usually 10 hectares of natural catchment, directed by grade banks, is appropriate for each 1000m 3 of storage. The peak flow runoff can be used to determine spillway dimensions. See Australian Rainfall and Runoff for more information. Improved roaded catchment area is determined using daily rainfall data, catchment runoff threshold, and target dam volume. Depth is adequate for providing sufficient water supplies and allowing for evaporation loss. Depth should be greater than annual evaporation, or greater than total evaporation for the chosen design period if the dam is for droughtproofing. Many sites are depth limited by saline watertables or other constraints. Sideslope batter ratio is usually 31. Freeboard is a minimum of 1m above the maximum water level. Where a silt pit is installed, overflow can be set out from the silt pit. Overflow is to discharge clear of the dam walls. Where there is a risk of crest erosion, materials other than earth can be used; flumes and chutes are potential applications. Use the Weir formula to calculate the crest width for the chosen overflow depth for a 1in20 to 1in50 year return period peak flow discharge. Calculations based on the greater return period are recommended for larger dams with large, natural or improved catchments. Chosen flow depth should be small enough that the dam freeboard is not compromised. Top of the hooded inlet or riser is set at the maximum water level of the dam and to discharge clear of the walls. Piped drop inlet, sump inlet and headwall with inlet pipes are set out above the dam. Top water surface of the inlet is set at the maximum water surface of the dam. Inlets are designed in such a way as to regulate surges of flow from high runoff events that would otherwise damage the dam. Trash rack or strainer screen should be installed to exclude paddock debris.

Inlet structures are constructed of concrete, sand bags, gabions or large diameter concrete pipes up to 900mm diameter installed vertically over inlet pipe ends. Inlet pipes are 150 or 200mm nominal bore PVC. To contain the approximate amount of runoff from a 10year average recurrence interval ARI storm, one inlet pipe is required per hectare of natural and improved catchment. Up to 3 pipes are required to contain a 50year ARI. The larger 200mm nominal bore pipes are used in agricultural areas with higher average annual rainfall. Silt pit with inlet pipes is recommended on all new hillside dams. Dams with roaded or improved catchments and less than 25ha of farmland catchment should have a minimum of 250m 3 of pit storage for each hectare of roaded or improved catchment, and a minimum pit storage of 1000m 3. Minimum of three 100 mm polyblack or PVC class 12 inlet pipes or two 150mm poly black or PVC class 12 minimum specification inlet pipes. Silt pit volumes ranging from 100 to 1000m 3 may be appropriate. There will be some loss of runoff through evaporation of water retained in the pit, as inlet pipes must be set above the settled debris and silt. Pipe sizes and numbers are to be matched to inflows similar to inlets above and to be fitted with a trash rack or strainer screen. Choose the layout of structure, catchment, inlet, outlet and safe overflow disposal.

Volume of completed structures needs to be confirmed by measuring and calculating the top, middle and bottom areas as well as measured depth. Back to top Safety and environmental aspects Before construction, consult the local government authority, neighbours and, where needed, a specialist engineer or trained contractor. Take care in siting and constructing farm dams to avoid the risk of injury to people and damage to property or infrastructure. Failure of dam walls can lead to flash flooding.

Eroded material from poorly planned, constructed or maintained structures can reduce flow capacities when deposited in downstream channels. In certain circumstances excavated tanks or hillside dams may need a licence so check with the Department of Water and Environmental Regulation to see if your excavated tank or hillside dam needs a licence. Local government councils often require their Chief Executive Officer is notified of proposals to construct farm dams near road reserves or land vested in the shire council. Common law rules govern the flow of surface water discharged into watercourses. To reduce the likelihood of crossboundary disputes construct waterimpounding structures so they do not have a detrimental effect on streams further down the catchment take reasonable steps to ensure the safety of another person and another persons property consider what effect planned earthworks will have on other people and seek consent from any person that may be affected take care during construction and maintenance to stop the loss of disturbed material from the site. Construction Prepare site by pegging and referencing corners square and rectangular shapes or centre circular shape. Measure fall across the site for calculating any storage volume above the excavation. Install a temporary bench mark TBM in a protected location. Remove topsoil and stockpile clear of the embankment wall location. Excavate core trench under the embankments if pervious materials are present under the topsoil. Core trench must extend 1m into impervious material. Compact the embankments with the bulldozer weight in 50 to 75mm layers or compact 150mm layers with a sheepsfoot roller. Embankment sideslope ratios can be confirmed by using an electronic builders slope finder or battometer. Install inlet and outlet pipes early in construction of the embankments. Spread the stockpiled topsoil on the outside batters and embankment top.

Topsoiling encourages vegetation and helps retain embankment moisture and resist cracking. Operation and maintenance Inspect embankments for safety and seepage. Check for cracking and piping and movement cracks. Look for erosion of sideslopes, inlets and outlets. There are several treatment options for leaky dams. Clear drop inlet, sump inlet, inlet pipes and silt pits of debris and eroded material. Vermin can burrow into inlets, outlets, embankments and improved catchment. Burrows should be dug out and repacked with clay. Vermin around the structure should be eradicated. Consider fencing the dam and catchment where supply is an important or droughtproofing structure. References Bligh, K J 1989, Soil conservation earthworks design manual, Department of Agriculture and Food, Western Australia. Joseph, Michigan. Keen, MG 1998, Common conservation works used in Western Australia, Agriculture Western Australia, Western Australia. Keen, MG 2001, Field pocket book of conservation earthworks formulae and tables, Department of Agriculture, Western Australia. Lewis, B 2002, Farm Dams, Land Link Press, Collingwood, Victoria. WorkSafe Western Australia 1996, Code of practice excavation, WorkSafe Western Australia, Perth. Locked Bag 4 Bentley Delivery Centre WA 6983. The intent of these guidelines is to provide direction to experienced dam design professionals so that the final product, the dam, is safe and the owners investment in professional engineering is maximized. The Project Engineer in charge of the design of a dam must be a registered professional engineer and have the training and experience to properly apply these guidelines to the specifics of the site and the needs of the owner. If the owners Project Engineer follows these guidelines and an appropriate engineering design package is submitted to IDNRs Division of Water, the time to obtain approval on the proposed work will be significantly reduced.

View the entire document Look for future changes to polices and procedures regarding inspection, enforcement, and permitting of dams in Indiana. This recent seismogenic zone provides important data to do the analysis, such as regional geologic setting, seismic history and seismology. In the Spanish code the Peak Ground Acceleration PGA for this area is 0.17 g, however in the current analysis the greatest soil acceleration registered is 0.35 g, which is about twice the value. Three accelerograms controlling earthquakes, by using the Engineering StrongMotion database, have been chosen to identify the seism's main characteristics. The dam analysis using different software needs to be done to calculate the vibration periods, the hydrodynamic pressure and the maximal vertical stresses. Timehistory analyses have been made to analyze the consequences of a dam failure and to estimate minor damage acceptance. The analyses show that the stresses exceed the tensile maximum allowed creating plastic hinges. There are other factors which can affect the dam's behavior such as the vertical component of the earthquake and the silt in the reservoir bottom. The concrete arch gravity dam needs to be modeled in two and threedimensions, in accordance to classic theoretical method and current codes, considering its big dimensions length of the crest 620 m; radius 500 m; area of the reservoir whit a operating level 308 Ha. A dam is an extremely strategic work which needs to be carefully designed to avoid environmental damage to water reservoirs and nearby facilities and for human security. Given that the recent sources of hazard in Spain are from 2015, it would be advisable to reassess the seismic hazard particularly related to existing dams of category A Spanish code in areas of high seismicity. Published by Elsevier Ltd. Recommended articles No articles found.

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