



Firestone GeoGard™ EPDM

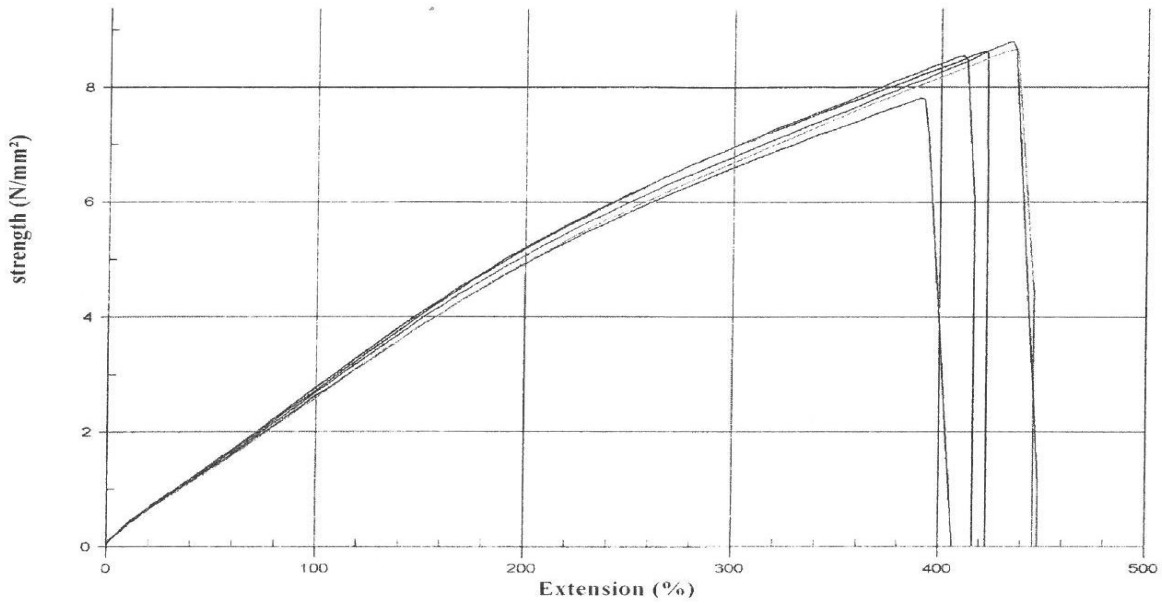
Expectation of behaviour in the event of an earthquake

Firestone hasn't done any specific test on its EPDM geomembrane in order to evaluate its behavior in case of an earthquake.

However, we had a very specific case (see details below) in Spain where a large water reservoir was located a few hundred meters from the epicenter of a very damaging earthquake. Despite the intensity of the event and the size of the project (huge water pressure on the geomembrane), the GeoGard has kept its water-tightness and its mechanical properties and continues to do its work today.

We believe that the reasons why this event didn't result in a catastrophic failure of the GeoGard are directly linked to its elasticity and flexibility. The GeoGard is a purely elastic membrane with no yield point (see below a typical stress strain curve of Firestone GeoGard EPDM). Now, it can be stretched up to 300% without being damaged. Another geomembrane with less elongation but higher tensile strength (like a reinforced EPDM for example) would probably have not behaved as well. The reinforcement reduces the elongation properties of the geomembrane and therefore its deformability and adaptability to external stresses.

The mechanical properties of the Firestone GeoGard EPDM are very interesting for applications where differential movements or an evolution of the quality of the substrate is expected (ground settlement, substrate erosion, landfill covers, seismic regions...).



Balsa de los Pozos - Lorca - Spain

Location:	Lorca Spain
Owner:	Mancomunidad de canales del Taibilla
Name:	Balsa de los Pozos
Geomembrane:	Firestone GeoGard™ EPDM
Installation year:	1998
Volume:	224.000 m³
Lined surface:	44.000 m²
Depth:	9,5 m



Aerial picture of the pond in 1998



Picture of the pond in 2013



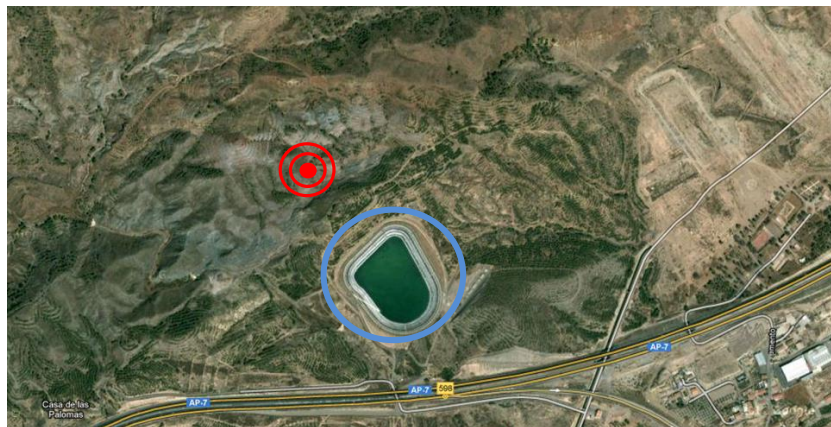
This reservoir was constructed to temporarily store water before purifying to produce potable water for the city of Lorca (Spain).



In 2011 the city of Lorca was severely damaged by a 5.1 earthquake (and several aftershocks). It was particularly destructive as its epicenter was only 1 km deep. The total strength of this event was similar to the explosion of 200 tons of TNT. As shown in the satellite picture below, the epicenter was located very close to the water reservoir (a few hundred meters).

After the earthquake, the maintenance team monitored the reservoir 24h a day for two weeks and discovered that even though the entire pond had been displaced by several tens of centimeters, no leaks or damage to the geomembrane were observed. No leaking water came through the water drainage system located under the liner.

The same membrane is still functioning in perfect working order today, 16 years after its installation.

The aerial picture and drawing below show the proximity between the epicenter of the main quake and the water pond.



 Epicenter of the earthquake  Location of the pond



Epicenter Damaged buildings Human victims Location of the pond

Below pictures show some of the damage caused by the earthquake a few kilometers from the epicenter.



