Aquadam Stability Calculation | Whitchurch engineering job no. | GFC2201

Norco Bluffs, Santa Ana River diversion project | Date | Jan 20 2022

This calculation assumes the Aqua Dam frictional forces act across the dam contact width. The elevation of the low point of the river bottom is taken as 552.0. The elevation of the retained water surface is 553.4. The retained water depth for calculation is 1.4'. The rate of flow in the river is 60cfs. The velocity of flow against the dam is assume to to be 60cfs at an angle of 35degrees Sin35x60cfs/125'x1.4'=.2ft/sec. The geotechnical report states the soils at the river bottom are soft type SM silty sand. Page 12 of the Geotechnical data Report gives a sample SM material as 91.6pcf dry density and 31.6% water content. This equates to 123pcf wet density. The Aquadam is expected to settle in this material. The dam volume is approximately 36cuft/ft. It could displace 36cuftx62.4pcf/123pcf=18.23cuft mud or approximately 1/2 the dam height.. Due to the soft soils a coefficient of friction of .1 has been chosen for this calculation. As the dam settles the passive pressure resisting sliding increases. This calculation shows a 4' dam is adequate with no settlement. However a taller dam is advised due to anticipated settlement.

Single dam

Dam height, h	4	feet	1.2	Meters
height of retained water, d	1.4	feet	0.4	Meters
Temp of water in dam and being retained assumed similar	68	deg F	20	deg C
Density of water, g	62.4	lbs/cuft	999.6	Kg/cuMeter
flow rate normal to dam, v	0.2	feet/second	0.06	Meters/Second
Coeficient of friction, m	0.1		0.1	
Contact width across bottom of dam, w	8.67	feet	2.642616	Meters
Lateral force from flow = dgv^2/(2*Gc)	0.1	lbs/ft dam length	0.8	N/M dam length
Lateral force from static height = gd^2/2	61	lbs/ft dam length	91	N/M dam length
Total lateral force	61	lbs/ft dam length	92	N/M dam length

Resistance to sliding

Total pressure acting on interior dam membrane contact width, = ghw	2,164	lbs/ft dam length	3,220	N/M dam length
Flotation force from static height = gdw/2	379	lbs/ft dam length	564	N/M dam length
Net gravitational force creating friction = ghw – gdw/2	1,785	lbs/ft dam length	2,657	N/M dam length
Frictional force resisting lateral movement = m (ghw-gdw/2)	179	lbs/ft dam length	265.69	N/M dam length
Factor of safety against lateral displacement = lat. force/frict. force	2.92		2.89	

Resistance to overturn

Moment imparted by static depth = .3333*d*gd^2/2	29	ftlbs/ft dam length	13	NM/M dam length
Moment imparted by flow = .5*d*dgv^2/2	0.04	ftlbs/ft dam length	0.17	NM/M dam length
Moment imparted by flotation = .6666*w*gdw/2	2,189	ftlbs/ft dam length	993	NM/M dam length
Sum of overturn moments	2,217	ftlbs/ft dam length	1,006	NM/M dam length
Resisting vertical moment dam width water weight = .5w*ghw	9,381	ftlbs/ft dam length	4,255	NM/M dam length
Factor of safety against overturn = resisting moment/overturn moment	4.2		4.2