Model in CADAM

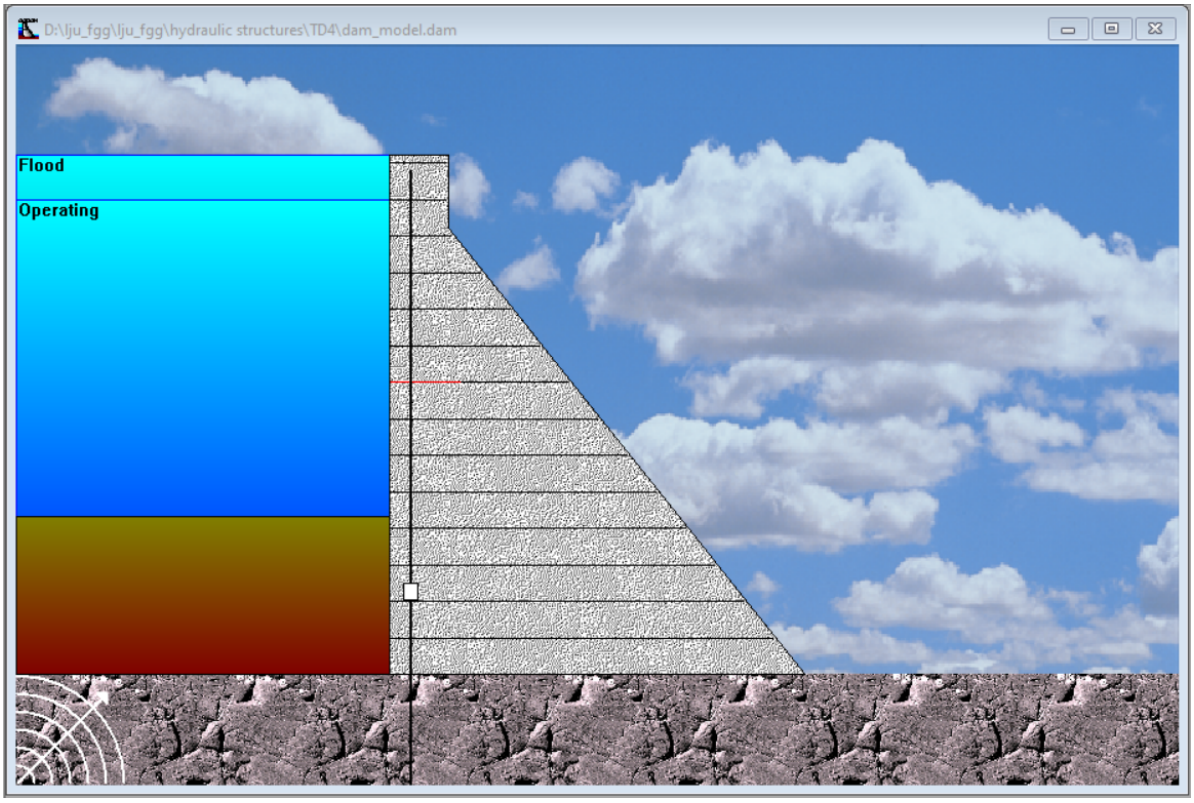
Arthur Guillot - Le Goff

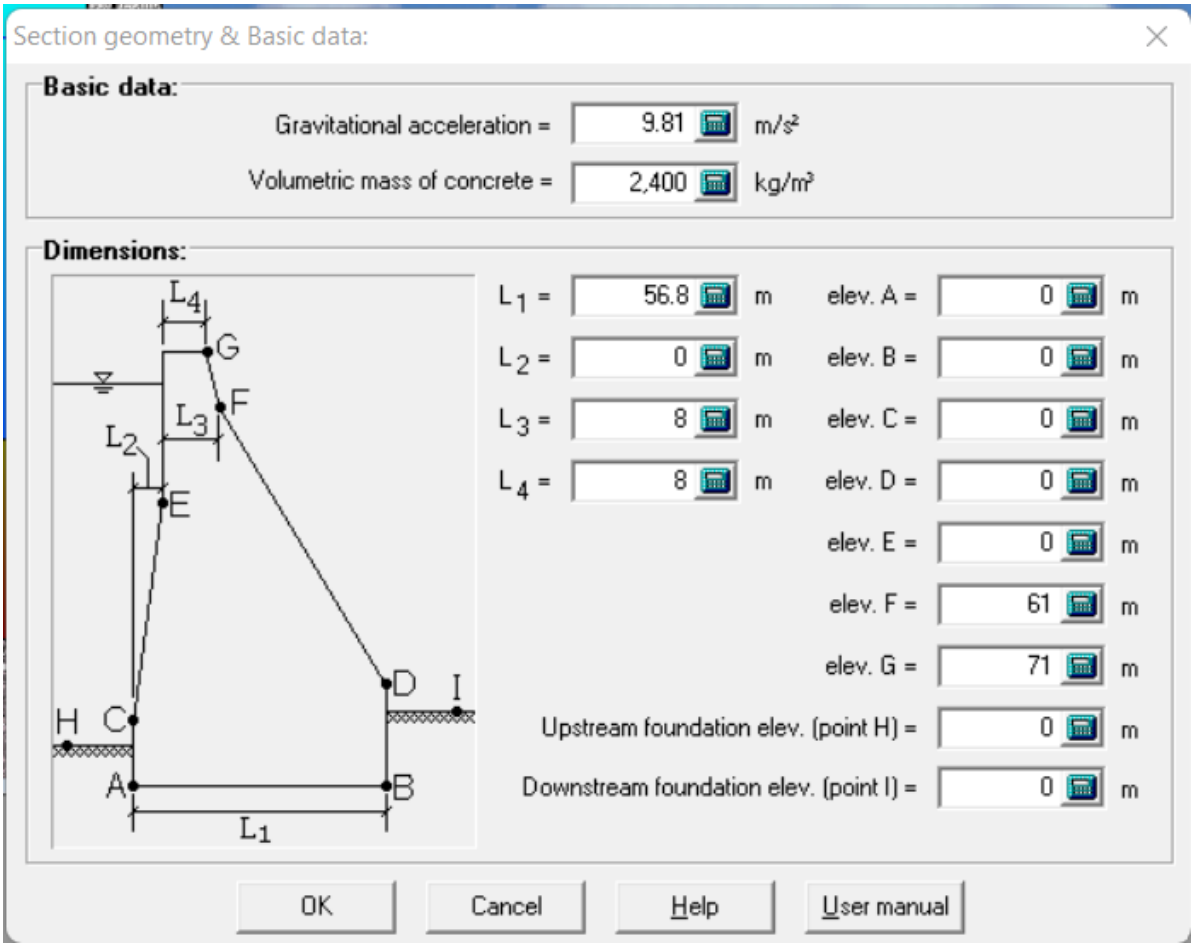
Autumn semester 2021-2022 | Hydroelectric power

Model in CADAM

- Our model
- Model results

Our model


D:\lju_fgg\lju_fgg\hydraulic structures\TD4\dam_model.dam
Flood
Operating


Section geometry & Basic data:
Basic data:
Gravitational acceleration = 9.81 m/s²
Volumetric mass of concrete = 2,400 kg/m³
Dimensions:
L1 = 56.8 m
L2 = 0 m
L3 = 8 m
L4 = 8 m
elev. A = 0 m
elev. B = 0 m
elev. C = 0 m
elev. D = 0 m
elev. E = 0 m
elev. F = 61 m
elev. G = 71 m
Upstream foundation elev. (point H) = 0 m
Downstream foundation elev. (point I) = 0 m
OK
Cancel
Help
User manual

Model results

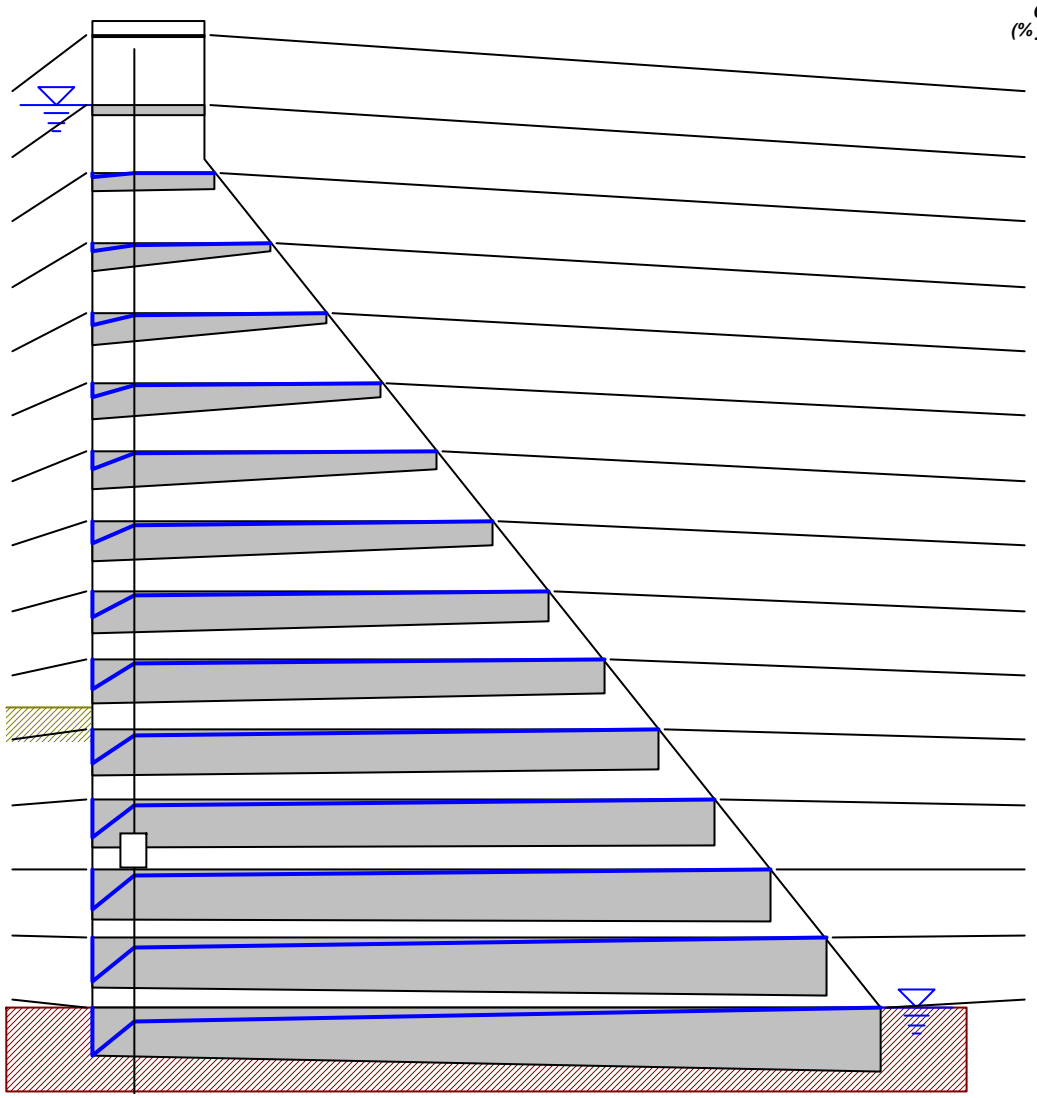
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Usual combination (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-23,544	-23,544	0,000		-23,544	-23,544	0,000
2		-141,264	-141,264	0,000		-141,264	-141,264	0,000
3		-249,473	-249,473	49,050		-199,468	-327,128	0,000
4		-375,329	-375,329	98,100		-110,818	-181,741	0,000
5		-428,578	-428,578	147,150		-129,611	-212,563	0,000
6		-464,497	-464,497	196,200		-180,473	-295,975	0,000
7		-495,457	-495,457	245,250		-243,901	-399,997	0,000
8		-525,049	-525,049	294,300		-313,134	-513,539	0,000
9		-554,460	-554,460	343,350		-385,362	-631,994	0,000
10		-584,093	-584,093	392,400		-459,264	-753,193	0,000
11		-614,065	-614,065	441,450		-534,167	-876,034	0,000
12		-643,890	-643,890	490,500		-610,196	-1000,721	0,000
13		-672,687	-672,687	539,550		-687,992	-1128,307	0,000
14		-660,721	-660,721	588,600		-765,430	-1255,305	0,000
15		-646,857	-646,857	637,650		-845,216	-1386,155	0,000

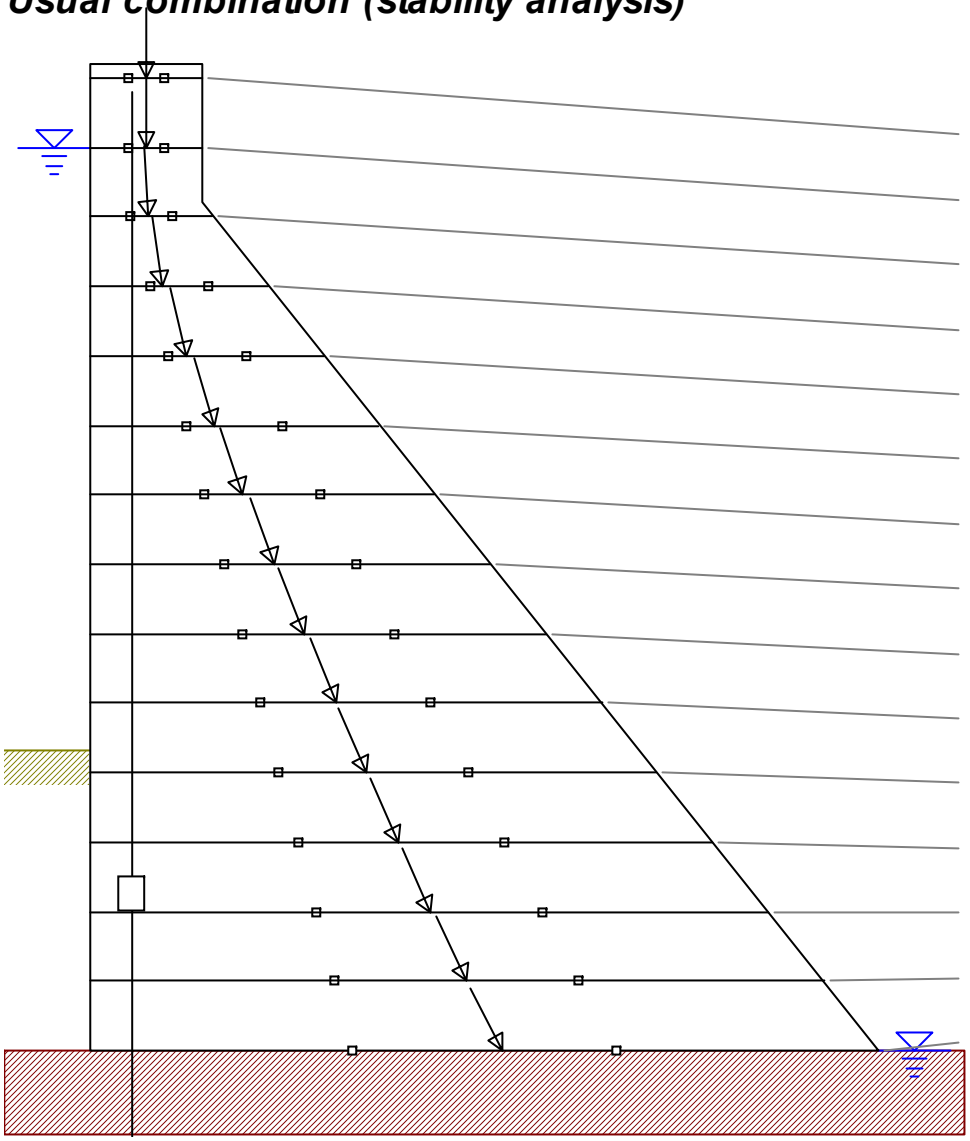


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Usual combination (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	> 100	> 100	> 100	> 100	> 100	-188,4	0,0	0,0	50,000
2	> 100	> 100	> 100	> 100	> 100	-1130,1	0,0	0,0	50,000
3	28,747	23,006	42,655	10,633	19,644	-1975,3	122,6	-322,7	48,144
4	11,147	9,059	26,346	6,765	13,893	-3111,3	490,5	-3611,5	40,932
5	7,285	6,068	23,399	5,260	12,545	-4688,8	1103,6	-7031,7	41,073
6	5,731	4,883	22,862	4,502	12,173	-6707,7	1962,0	-10240,0	42,661
7	4,918	4,271	22,935	4,058	12,126	-9168,0	3065,6	-12893,1	44,329
8	4,427	3,905	23,168	3,772	12,205	-12069,8	4414,5	-14647,6	45,786
9	4,100	3,663	23,428	3,574	12,336	-15413,1	6008,6	-15160,1	47,001
10	3,869	3,494	23,676	3,429	12,485	-19197,8	7848,0	-14087,4	48,006
11	3,695	3,366	23,898	3,320	12,636	-23423,9	9937,4	-11083,4	48,840
12	3,541	3,250	24,101	3,233	12,784	-28091,5	12343,0	-5635,5	49,552
13	3,402	3,143	24,294	3,158	12,925	-33200,6	15086,2	3037,4	50,187
14	3,192	2,960	16,736	2,868	9,727	-37650,4	18167,1	24326,0	51,224
15	3,014	2,804	13,284	2,652	8,015	-42374,9	21585,6	53329,6	52,216
	3,000	***1,500***	***2,000***	***2,000***	***1,200***				

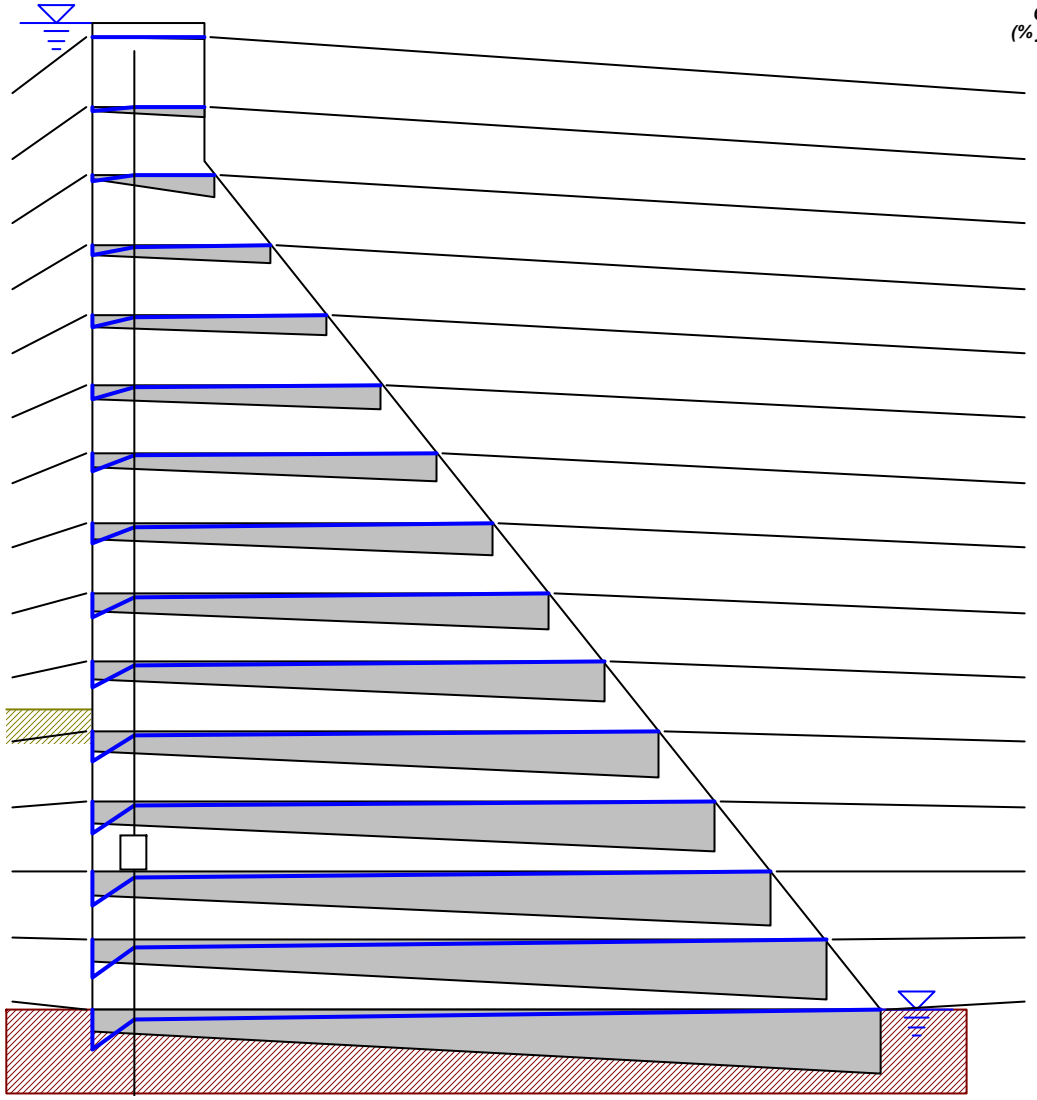
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Flood combination (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-13,581	-13,581	9,810		-23,697	-23,697	0,000
2		-66,769	-66,769	58,860		-184,857	-184,857	0,000
3		-57,588	-57,588	107,910		-362,458	-594,431	0,000
4		-158,838	-158,838	156,960		-304,685	-499,683	0,000
5		-197,597	-197,597	206,010		-341,252	-559,653	0,000
6		-224,054	-224,054	255,060		-403,598	-661,900	0,000
7		-248,367	-248,367	304,110		-475,042	-779,068	0,000
8		-273,039	-273,039	353,160		-550,183	-902,300	0,000
9		-298,664	-298,664	402,210		-626,945	-1028,190	0,000
10		-325,295	-325,295	451,260		-704,435	-1155,273	0,000
11		-352,828	-352,828	500,310		-782,247	-1282,885	0,000
12		-380,633	-380,633	549,360		-860,683	-1411,520	0,000
13		-407,728	-407,728	598,410		-940,503	-1542,425	0,000
14		-394,311	-394,311	647,460		-1019,667	-1672,253	0,000
15		-379,194	-379,194	696,510		-1100,942	-1805,544	0,000

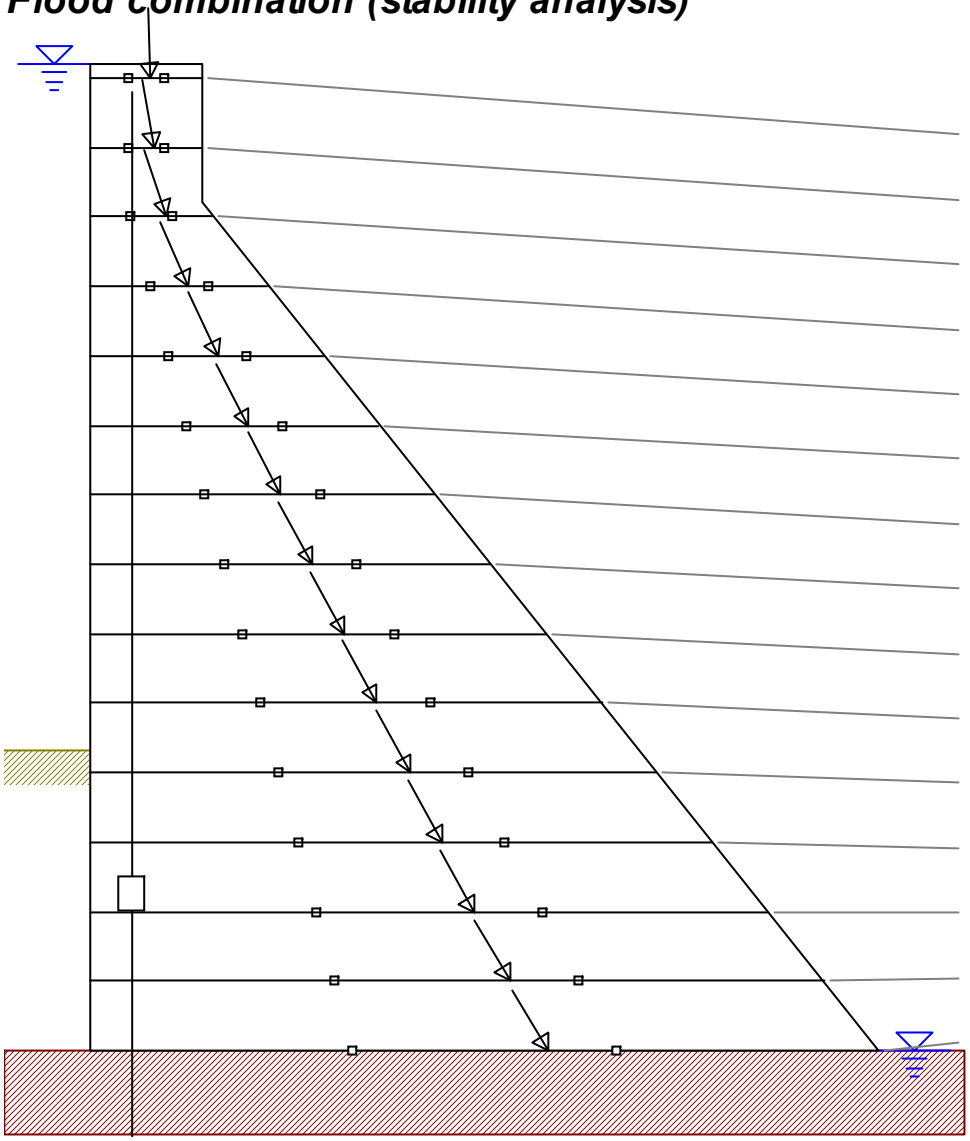


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Flood combination (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	> 100	43,416	7,216	3,572	4,800	-149,1	4,9	54,0	54,523
2	11,765	8,140	22,378	4,021	9,143	-1006,5	176,6	629,8	57,822
3	5,633	4,447	23,850	2,629	8,929	-1848,2	593,5	1967,4	62,097
4	4,189	3,374	21,385	2,602	8,683	-2966,5	1255,7	1991,3	55,244
5	3,610	2,988	21,473	2,528	8,961	-4526,3	2163,1	3378,8	54,443
6	3,313	2,812	22,010	2,482	9,363	-6527,6	3315,8	6473,2	54,768
7	3,139	2,718	22,561	2,457	9,779	-8970,3	4713,7	11617,9	55,222
8	3,026	2,663	23,036	2,445	10,171	-11854,4	6356,9	19156,2	55,611
9	2,948	2,629	23,431	2,439	10,531	-15180,0	8245,3	29431,5	55,911
10	2,891	2,607	23,756	2,438	10,856	-18947,0	10379,0	42787,2	56,137
11	2,847	2,591	24,025	2,439	11,150	-23155,5	12762,6	59569,0	56,305
12	2,800	2,568	24,256	2,440	11,414	-27805,5	15462,6	80290,0	56,445
13	2,751	2,540	24,464	2,440	11,654	-32896,9	18500,1	105731,0	56,586
14	2,630	2,437	17,356	2,296	9,052	-37329,0	21875,3	145282,6	57,371
15	2,524	2,346	13,923	2,181	7,589	-42035,8	25588,1	194044,3	58,127
	2,000	***1,300***	***1,100***	***1,100***	***1,100***				

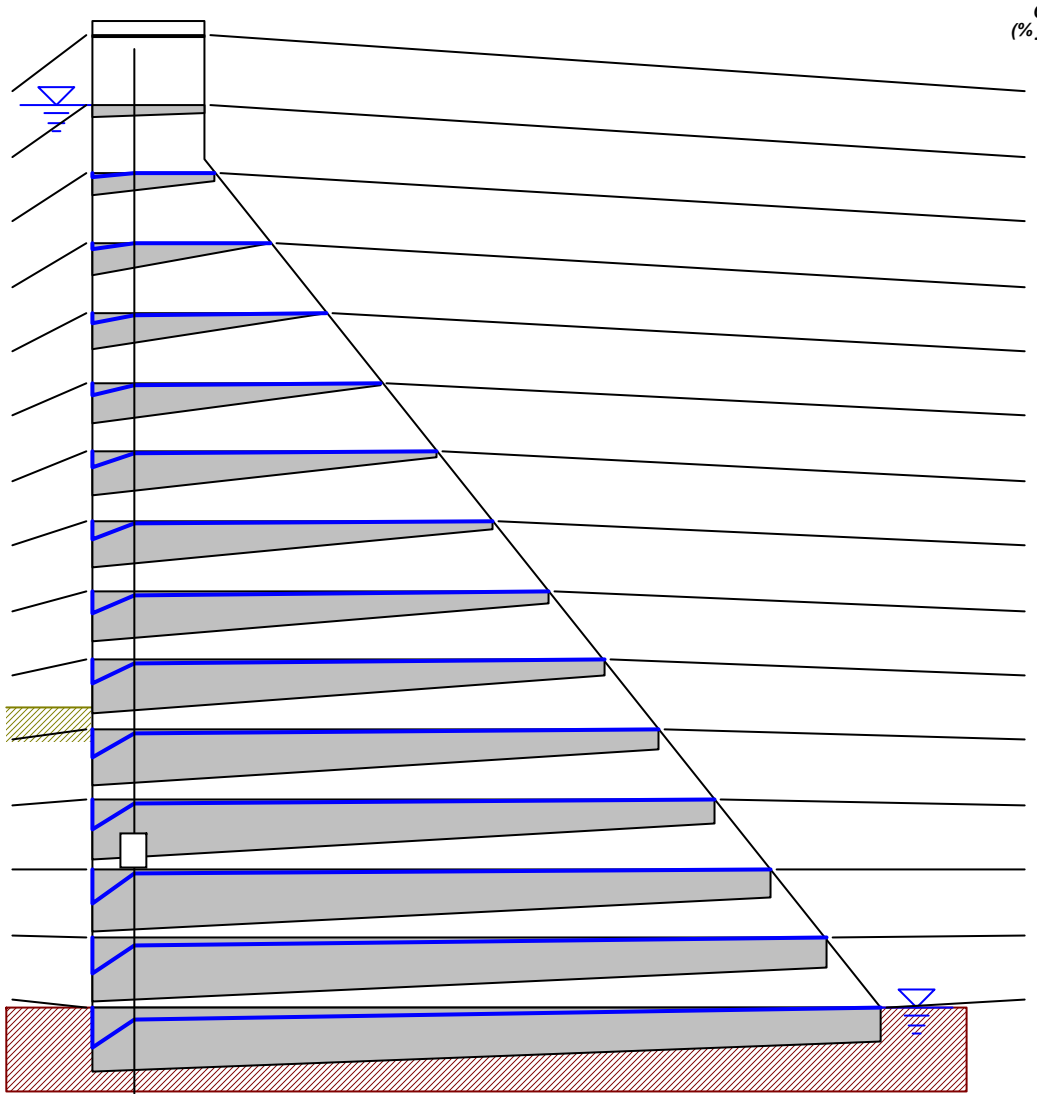
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Peak accelerations (stress analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-25,997	-25,997	0,000		-24,231	-24,231	0,000
2		-182,466	-182,466	0,000		-118,897	-118,897	0,000
3		-364,157	-364,157	49,050		-116,319	-190,763	0,000
4		-514,810	-514,810	98,100		-6,261	-10,268	0,000
5		-591,079	-591,079	147,150		-7,546	-12,375	0,000
6		-650,098	-650,098	196,200		-41,718	-68,418	0,000
7		-704,260	-704,260	245,250		-88,818	-145,662	0,000
8		-757,051	-757,051	294,300		-141,998	-232,876	0,000
9		-809,583	-809,583	343,350		-198,421	-325,411	0,000
10		-862,220	-862,220	392,400		-256,752	-421,073	0,000
11		-915,065	-915,065	441,450		-316,295	-518,723	0,000
12		-967,805	-967,805	490,500		-376,982	-618,250	0,000
13		-1019,631	-1019,631	539,550		-439,367	-720,562	0,000
14		-1030,750	-1030,750	588,600		-501,374	-822,253	0,000
15		-1039,962	-1039,962	637,650		-565,764	-927,853	0,000

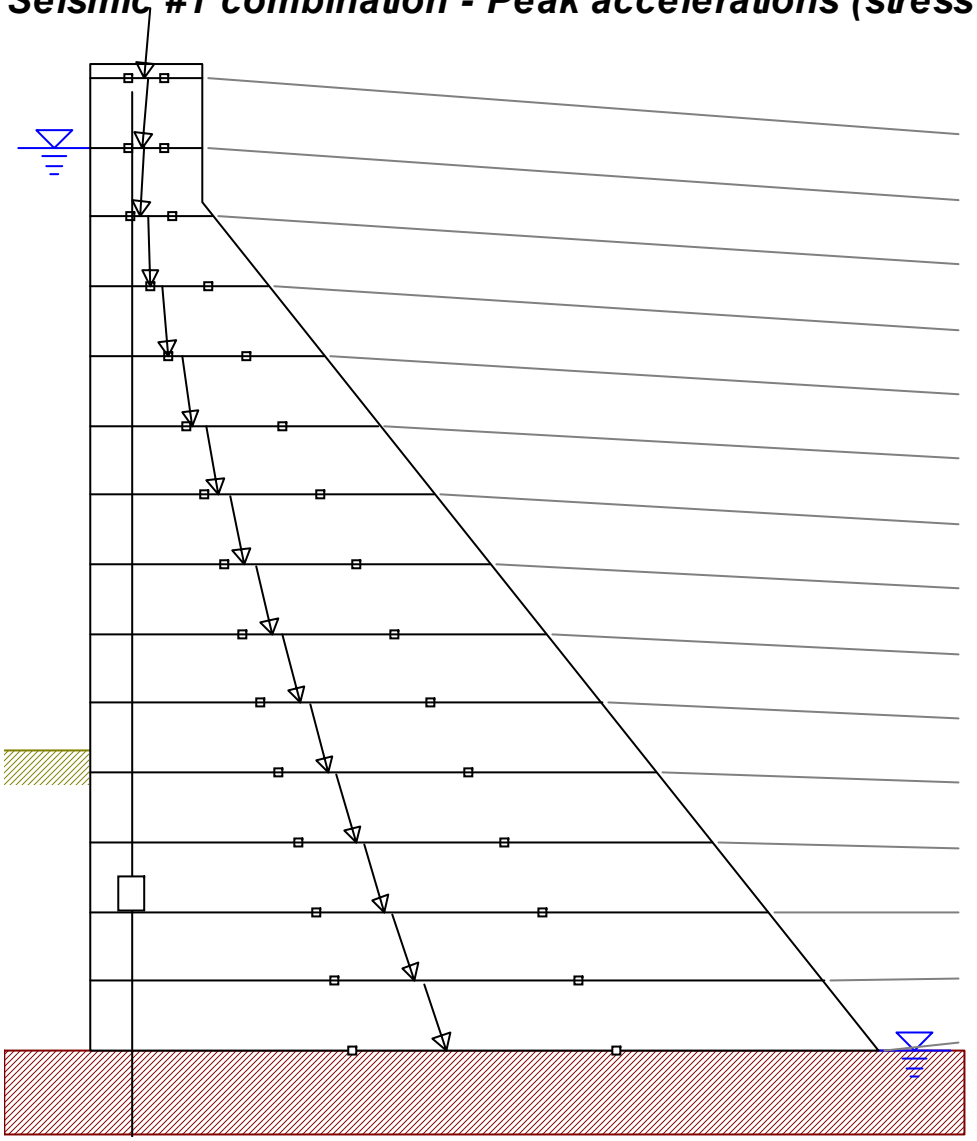


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Peak accelerations (stress analysis) (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	49,213	15,234	85,333	> 100	> 100	-200,9	-18,8	-9,4	49,414
2	20,897	15,234	14,222	> 100	> 100	-1205,5	-113,0	-339,0	46,484
3	29,514	23,934	6,406	12,649	20,954	-2114,1	-126,2	-1599,4	41,403
4	> 100	95,548	5,039	7,932	14,819	-3334,9	49,8	-6943,4	33,734
5	20,591	17,345	4,977	6,136	13,381	-5028,5	414,0	-13724,7	33,754
6	12,291	10,578	5,189	5,235	12,984	-7194,9	971,4	-21934,1	35,343
7	9,292	8,142	5,452	4,708	12,934	-9834,2	1725,0	-31543,4	37,066
8	7,769	6,908	5,708	4,367	13,019	-12946,3	2676,6	-42512,5	38,598
9	6,853	6,168	5,943	4,131	13,158	-16531,3	3827,7	-54792,6	39,895
10	6,245	5,677	6,155	3,957	13,317	-20589,1	5179,6	-68329,1	40,982
11	5,812	5,327	6,346	3,826	13,479	-25119,7	6734,4	-83061,4	41,896
12	5,454	5,035	6,516	3,720	13,636	-30123,2	8544,5	-98817,1	42,678
13	5,144	4,777	6,669	3,631	13,787	-35599,6	10642,6	-115155,4	43,371
14	4,756	4,432	6,063	3,294	10,375	-40448,1	13032,8	-122984,7	44,241
15	4,433	4,144	5,639	3,044	8,549	-45602,6	15717,4	-127489,9	45,078
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				

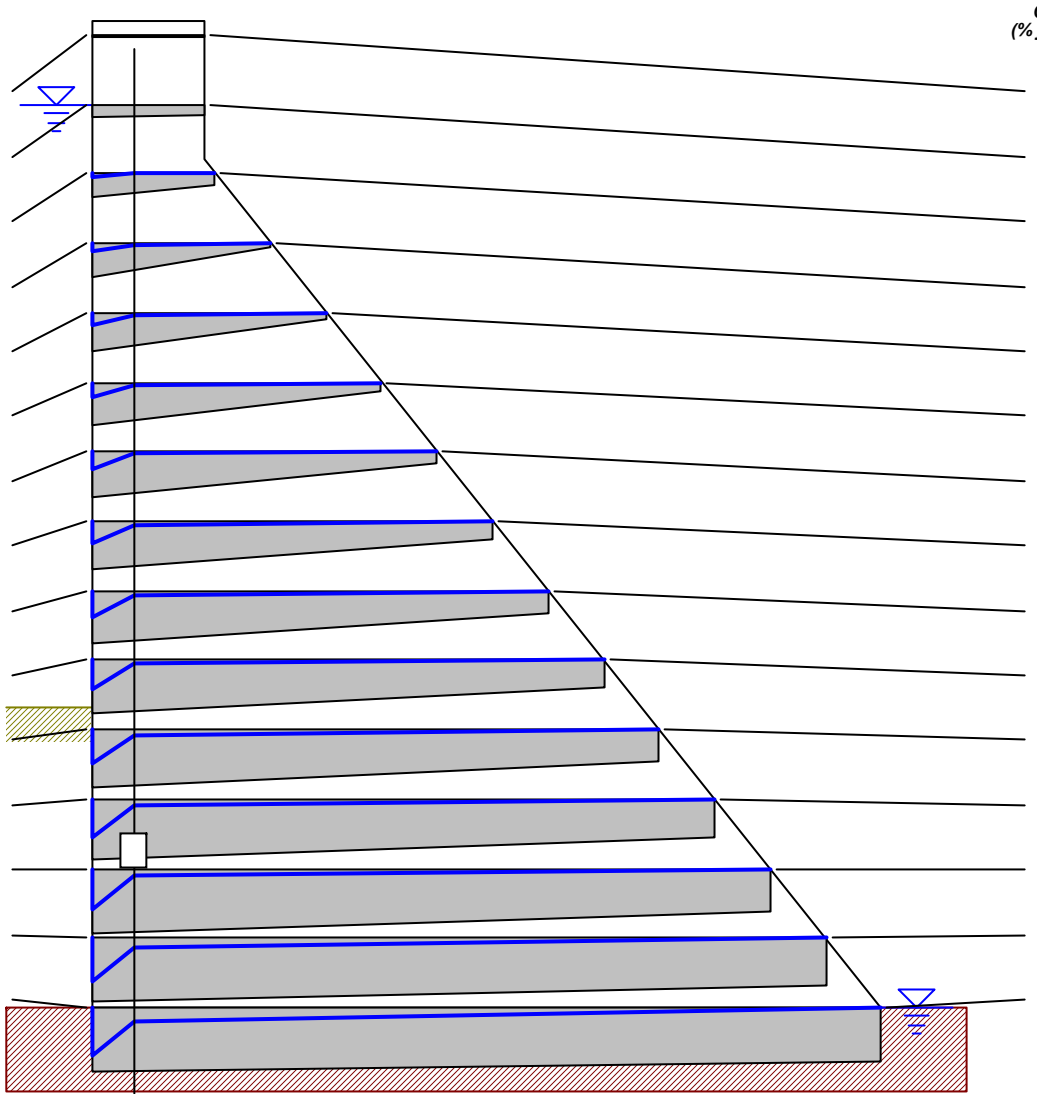
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Sustained accelerations (stability analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-24,770	-24,770	0,000		-23,887	-23,887	0,000
2		-161,865	-161,865	0,000		-130,081	-130,081	0,000
3		-306,815	-306,815	49,050		-157,894	-258,946	0,000
4		-445,070	-445,070	98,100		-58,539	-96,005	0,000
5		-509,829	-509,829	147,150		-68,579	-112,469	0,000
6		-557,298	-557,298	196,200		-111,096	-182,197	0,000
7		-599,859	-599,859	245,250		-166,360	-272,830	0,000
8		-641,051	-641,051	294,300		-227,566	-373,209	0,000
9		-682,022	-682,022	343,350		-291,892	-478,704	0,000
10		-723,158	-723,158	392,400		-358,009	-587,134	0,000
11		-764,566	-764,566	441,450		-425,231	-697,380	0,000
12		-805,849	-805,849	490,500		-493,590	-809,487	0,000
13		-846,160	-846,160	539,550		-563,681	-924,436	0,000
14		-845,737	-845,737	588,600		-633,403	-1038,781	0,000
15		-843,411	-843,411	637,650		-705,491	-1157,006	0,000

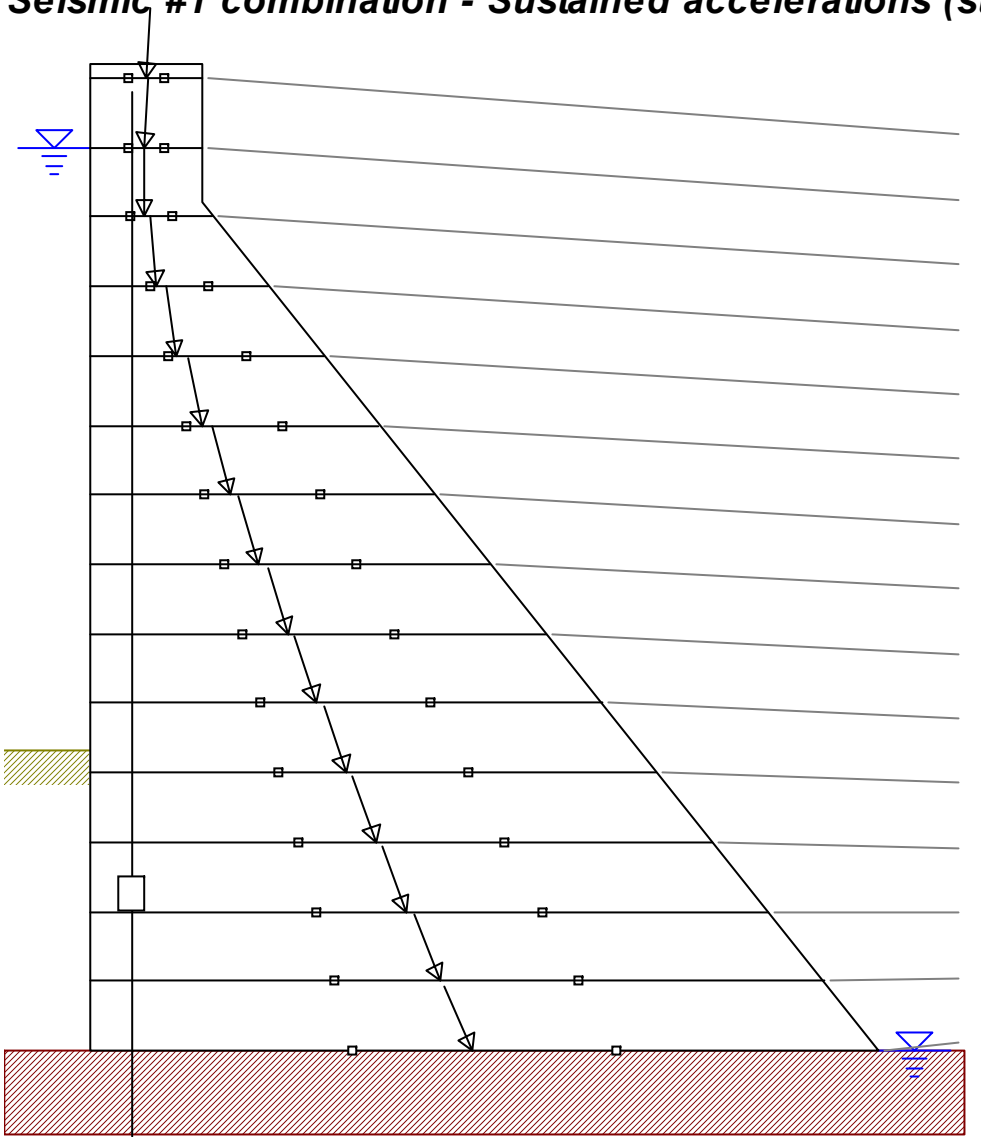


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Sustained accelerations (stability analysis) (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	97,473	29,515	> 100	> 100	> 100	-194,6	-9,4	-4,7	49,698
2	40,841	29,515	27,556	> 100	> 100	-1167,8	-56,5	-169,5	48,185
3	> 100	> 100	10,886	11,641	20,299	-2044,7	-1,8	-961,0	44,659
4	20,828	17,037	8,295	7,348	14,356	-3223,1	270,2	-5277,4	37,208
5	10,915	9,144	8,066	5,698	12,963	-4858,6	758,8	-10378,2	37,285
6	7,903	6,769	8,324	4,869	12,578	-6951,3	1466,7	-16087,1	38,874
7	6,493	5,665	8,678	4,383	12,530	-9501,1	2395,3	-22218,3	40,571
8	5,688	5,038	9,029	4,070	12,612	-12508,1	3545,5	-28580,1	42,066
9	5,172	4,638	9,351	3,852	12,747	-15972,2	4918,2	-34976,4	43,324
10	4,814	4,362	9,641	3,693	12,901	-19893,5	6513,8	-41208,3	44,371
11	4,550	4,158	9,900	3,573	13,057	-24271,9	8335,9	-47072,5	45,247
12	4,324	3,980	10,129	3,477	13,210	-29107,4	10443,8	-52226,4	45,995
13	4,122	3,819	10,336	3,395	13,356	-34400,1	12864,4	-56059,0	46,661
14	3,846	3,575	8,811	3,081	10,051	-39049,3	15600,0	-49329,4	47,607
15	3,612	3,368	7,848	2,848	8,282	-43988,8	18651,5	-37080,2	48,516
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				

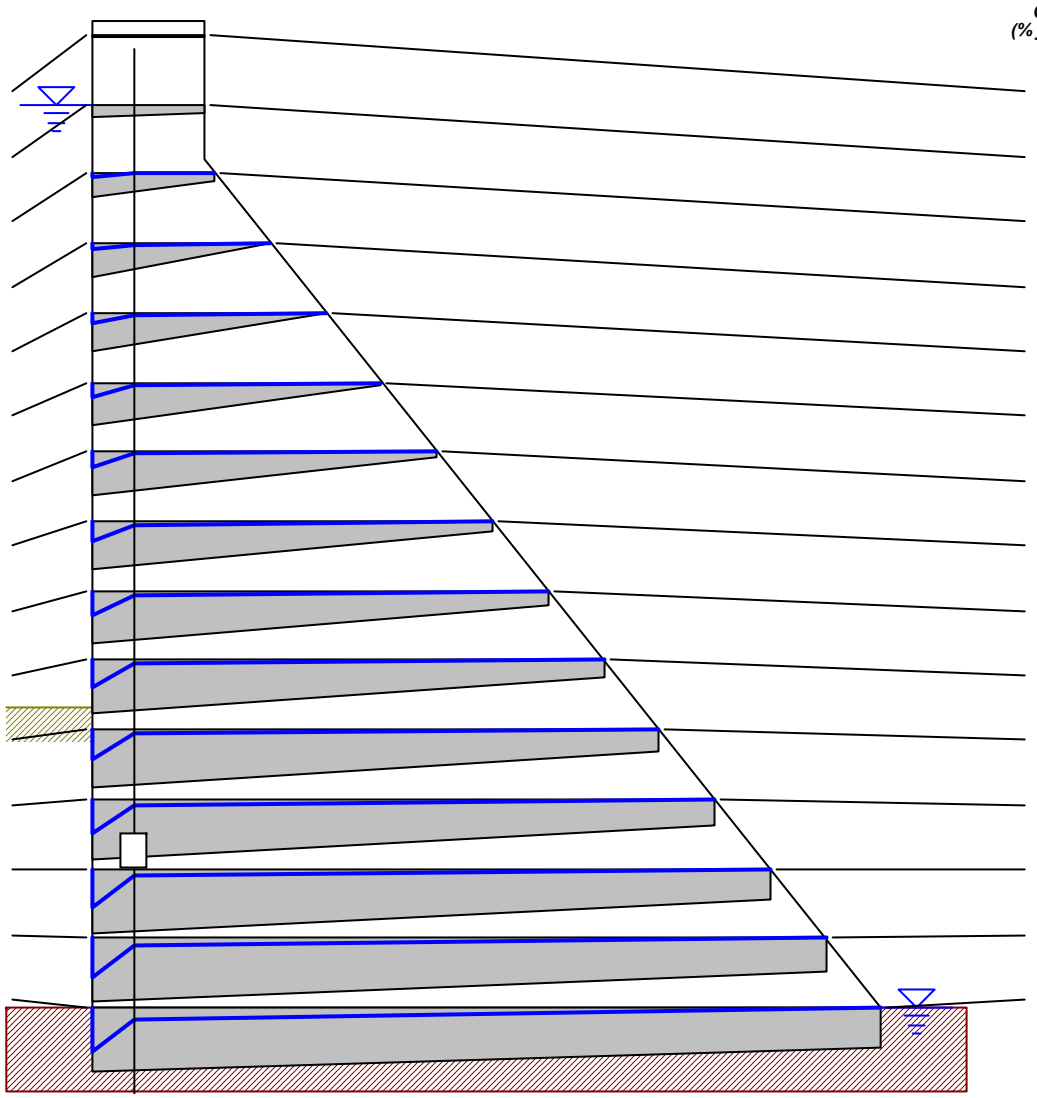
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Peak accelerations (stress analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-24,427	-24,427	0,000		-22,661	-22,661	0,000
2		-173,048	-173,048	0,000		-109,480	-109,480	0,000
3		-344,297	-344,297	49,050		-104,644	-171,617	0,000
4		-482,338	-482,338	98,100		-3,808	-6,246	0,000
5		-550,287	-550,287	147,150		-7,902	-12,959	0,000
6		-601,858	-601,858	196,200		-43,111	-70,703	0,000
7		-648,742	-648,742	245,250		-90,615	-148,609	0,000
8		-694,247	-694,247	294,300		-143,936	-236,054	0,000
9		-739,440	-739,440	343,350		-200,382	-328,627	0,000
10		-784,677	-784,677	392,400		-258,681	-424,236	0,000
11		-830,066	-830,066	441,450		-318,165	-521,791	0,000
12		-875,302	-875,302	490,500		-378,784	-621,205	0,000
13		-919,583	-919,583	539,550		-441,096	-723,398	0,000
14		-923,120	-923,120	588,600		-503,031	-824,971	0,000
15		-924,722	-924,722	637,650		-567,352	-930,457	0,000

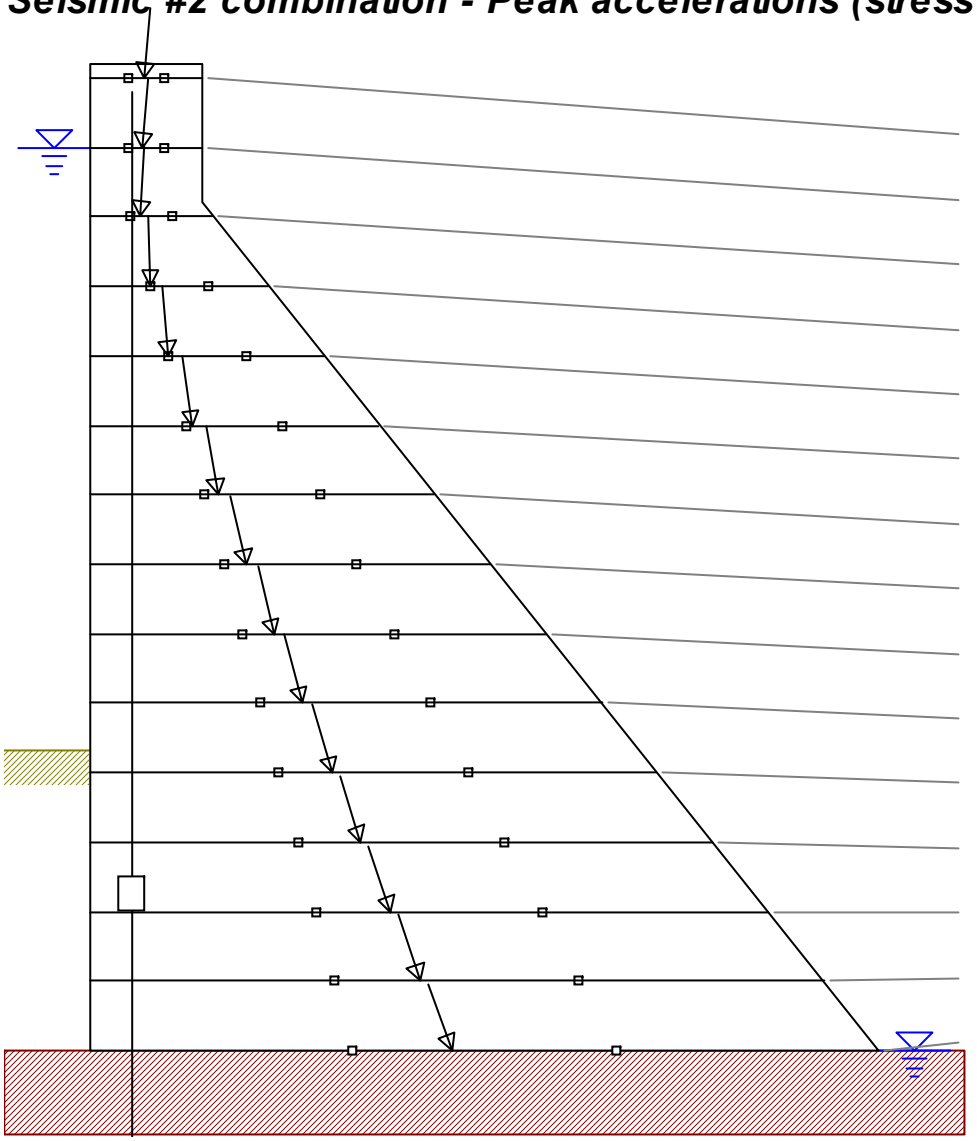


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Peak accelerations (stress analysis) (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	48,260	14,281	80,000	> 100	> 100	-188,4	-18,8	-9,4	49,375
2	19,945	14,281	13,333	> 100	> 100	-1130,1	-113,0	-339,0	46,250
3	27,944	22,363	6,015	11,940	19,644	-1975,3	-126,2	-1546,6	41,103
4	> 100	89,144	4,753	7,481	13,893	-3111,3	49,8	-6533,5	33,594
5	19,420	16,174	4,714	5,785	12,545	-4688,8	414,0	-12756,9	33,805
6	11,574	9,861	4,929	4,935	12,173	-6707,7	971,4	-20144,7	35,561
7	8,741	7,591	5,189	4,438	12,126	-9168,0	1725,0	-28605,9	37,419
8	7,301	6,440	5,441	4,116	12,205	-12069,8	2676,6	-38037,5	39,057
9	6,436	5,751	5,672	3,892	12,336	-15413,1	3827,7	-48328,3	40,440
10	5,862	5,293	5,879	3,729	12,485	-19197,8	5179,6	-59360,4	41,598
11	5,452	4,967	6,066	3,604	12,636	-23423,9	6734,4	-71010,9	42,570
12	5,115	4,695	6,232	3,505	12,784	-28091,5	8544,5	-83044,4	43,401
13	4,822	4,455	6,381	3,420	12,925	-33200,6	10642,6	-94957,2	44,139
14	4,450	4,126	5,803	3,103	9,727	-37650,4	13032,8	-97595,0	45,091
15	4,139	3,850	5,399	2,867	8,015	-42374,9	15717,4	-96080,0	46,008
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				

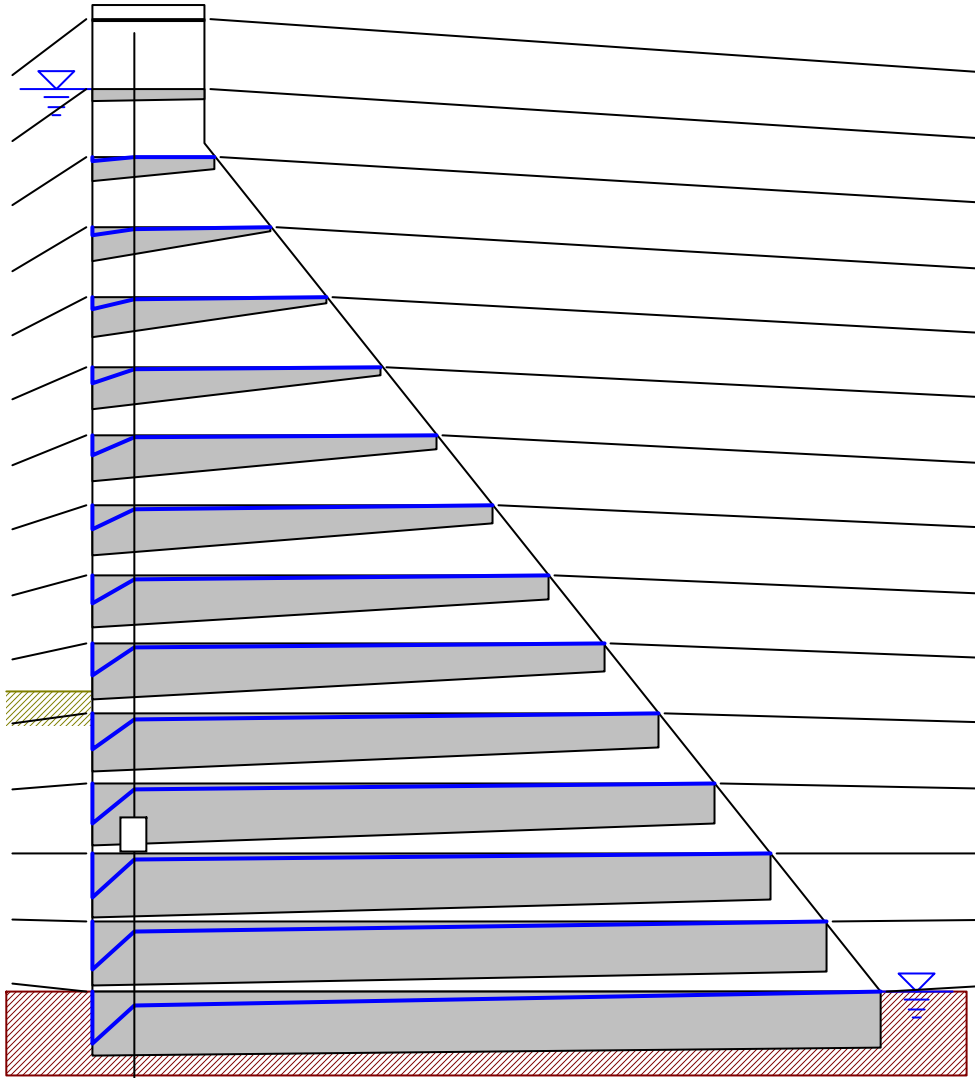
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Sustained accelerations (stability analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-23,985	-23,985	0,000		-23,103	-23,103	0,000
2		-157,156	-157,156	0,000		-125,372	-125,372	0,000
3		-296,885	-296,885	49,050		-152,056	-249,372	0,000
4		-428,834	-428,834	98,100		-57,313	-93,993	0,000
5		-489,432	-489,432	147,150		-68,757	-112,761	0,000
6		-533,177	-533,177	196,200		-111,792	-183,339	0,000
7		-572,099	-572,099	245,250		-167,258	-274,304	0,000
8		-609,648	-609,648	294,300		-228,535	-374,798	0,000
9		-646,949	-646,949	343,350		-292,873	-480,312	0,000
10		-684,384	-684,384	392,400		-358,973	-588,716	0,000
11		-722,065	-722,065	441,450		-426,167	-698,914	0,000
12		-759,595	-759,595	490,500		-494,491	-810,965	0,000
13		-796,134	-796,134	539,550		-564,545	-925,855	0,000
14		-791,919	-791,919	588,600		-634,232	-1040,140	0,000
15		-785,788	-785,788	637,650		-706,285	-1158,308	0,000

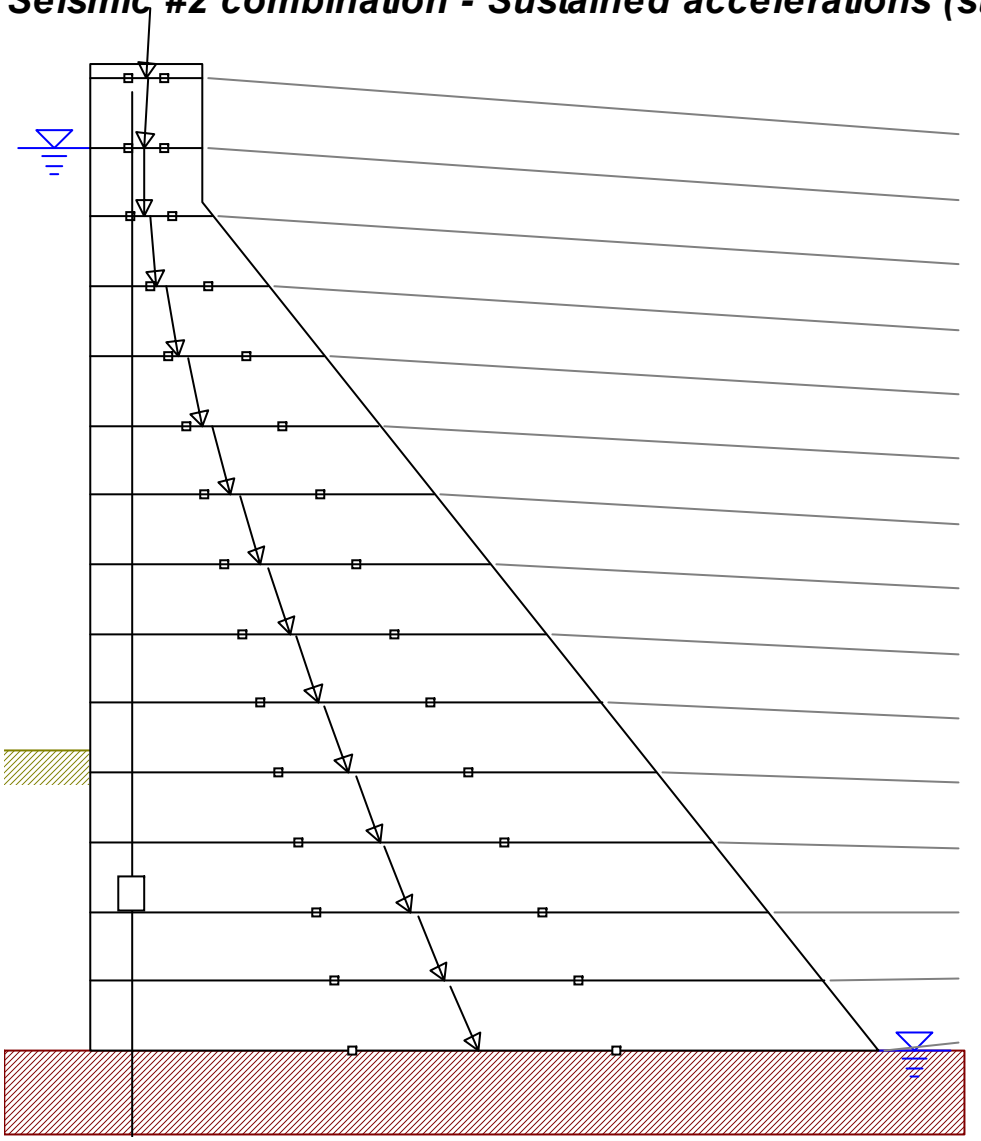


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Sustained accelerations (stability analysis) (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	96,521	28,563	> 100	> 100	> 100	-188,4	-9,4	-4,7	49,688
2	39,889	28,563	26,667	> 100	> 100	-1130,1	-56,5	-169,5	48,125
3	> 100	> 100	10,543	11,286	19,644	-1975,3	-1,8	-934,6	44,623
4	20,237	16,447	8,053	7,123	13,893	-3111,3	270,2	-5072,5	37,263
5	10,596	8,825	7,847	5,522	12,545	-4688,8	758,8	-9894,3	37,439
6	7,666	6,531	8,110	4,719	12,173	-6707,7	1466,7	-15192,3	39,111
7	6,295	5,466	8,464	4,248	12,126	-9168,0	2395,3	-20749,5	40,874
8	5,512	4,862	8,813	3,944	12,205	-12069,8	3545,5	-26342,5	42,422
9	5,009	4,476	9,133	3,733	12,336	-15413,1	4918,2	-31744,1	43,721
10	4,661	4,209	9,420	3,579	12,485	-19197,8	6513,8	-36723,7	44,802
11	4,405	4,013	9,676	3,462	12,636	-23423,9	8335,9	-41047,0	45,705
12	4,185	3,841	9,903	3,369	12,784	-28091,5	10443,8	-44339,6	46,477
13	3,989	3,686	10,107	3,289	12,925	-33200,6	12864,4	-45959,5	47,163
14	3,718	3,447	8,618	2,985	9,727	-37650,4	15600,0	-36634,0	48,157
15	3,488	3,245	7,678	2,760	8,015	-42374,9	18651,5	-21374,6	49,112
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				

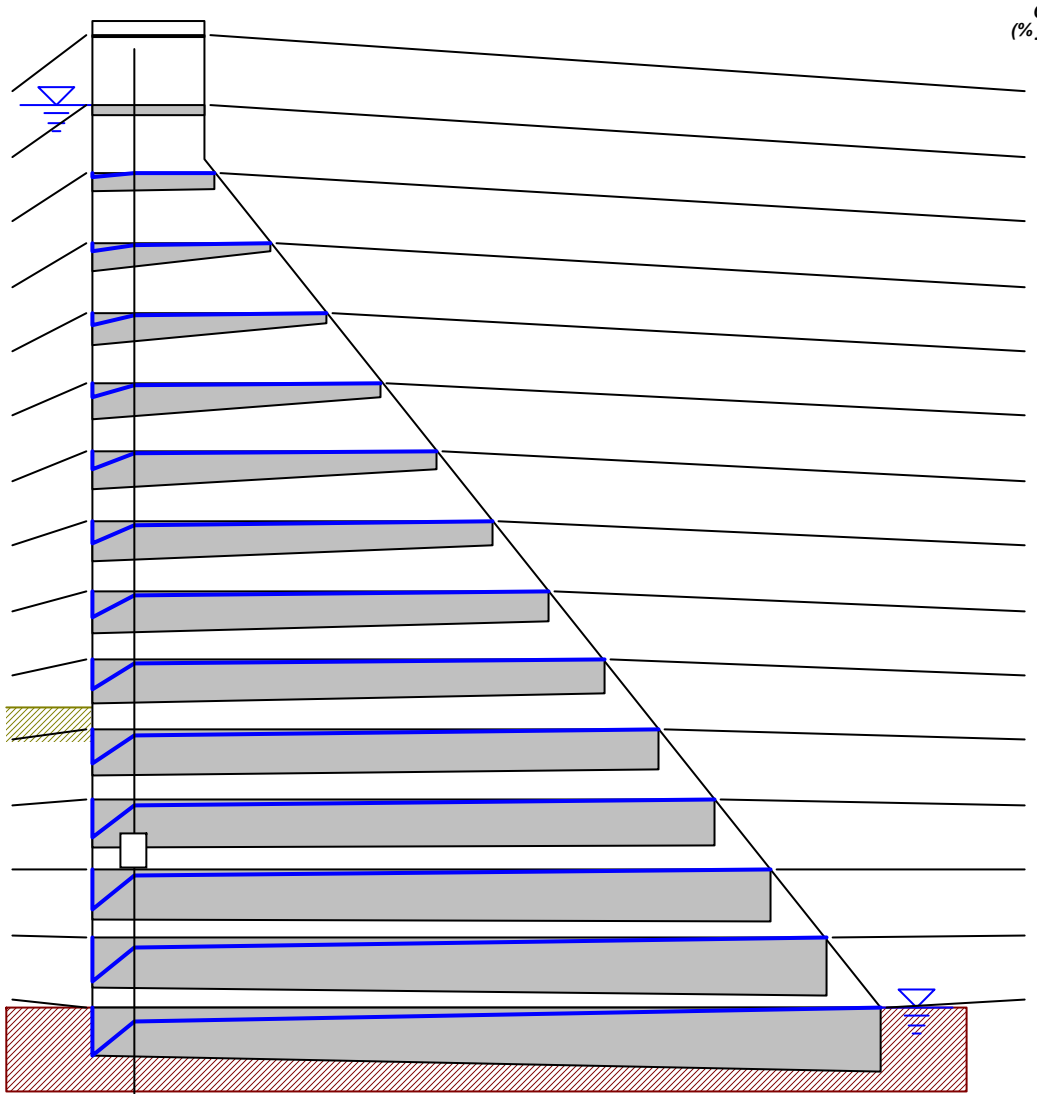
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Usual combination (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-23,544	-23,544	0,000		-23,544	-23,544	0,000
2		-141,264	-141,264	0,000		-141,264	-141,264	0,000
3		-249,473	-249,473	49,050		-199,468	-327,128	0,000
4		-375,329	-375,329	98,100		-110,818	-181,741	0,000
5		-428,578	-428,578	147,150		-129,611	-212,563	0,000
6		-464,497	-464,497	196,200		-180,473	-295,975	0,000
7		-495,457	-495,457	245,250		-243,901	-399,997	0,000
8		-525,049	-525,049	294,300		-313,134	-513,539	0,000
9		-554,460	-554,460	343,350		-385,362	-631,994	0,000
10		-584,093	-584,093	392,400		-459,264	-753,193	0,000
11		-614,065	-614,065	441,450		-534,167	-876,034	0,000
12		-643,890	-643,890	490,500		-610,196	-1000,721	0,000
13		-672,687	-672,687	539,550		-687,992	-1128,307	0,000
14		-660,721	-660,721	588,600		-765,430	-1255,305	0,000
15		-646,857	-646,857	637,650		-845,216	-1386,155	0,000

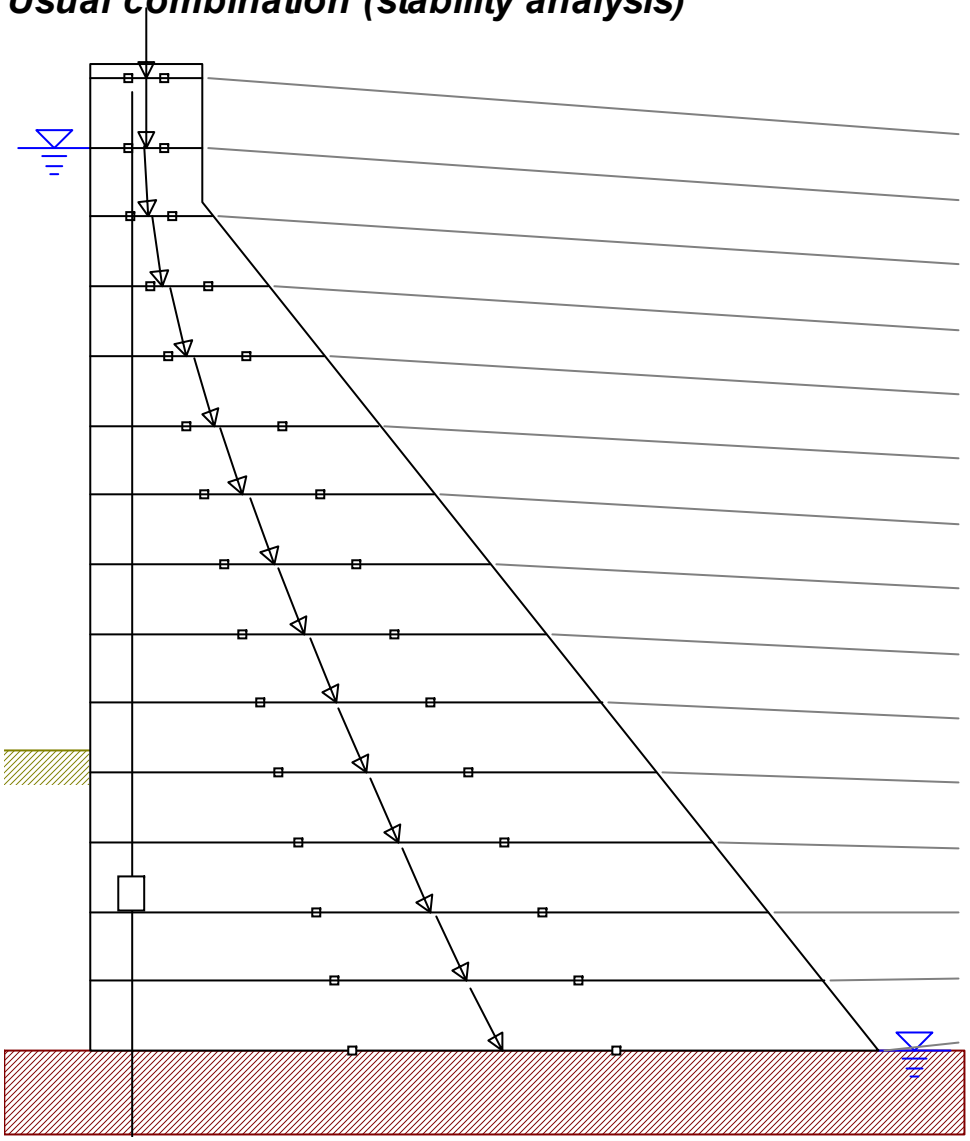


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Usual combination (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	> 100	> 100	> 100	> 100	> 100	-188,4	0,0	0,0	50,000
2	> 100	> 100	> 100	> 100	> 100	-1130,1	0,0	0,0	50,000
3	28,747	23,006	42,655	10,633	19,644	-1975,3	122,6	-322,7	48,144
4	11,147	9,059	26,346	6,765	13,893	-3111,3	490,5	-3611,5	40,932
5	7,285	6,068	23,399	5,260	12,545	-4688,8	1103,6	-7031,7	41,073
6	5,731	4,883	22,862	4,502	12,173	-6707,7	1962,0	-10240,0	42,661
7	4,918	4,271	22,935	4,058	12,126	-9168,0	3065,6	-12893,1	44,329
8	4,427	3,905	23,168	3,772	12,205	-12069,8	4414,5	-14647,6	45,786
9	4,100	3,663	23,428	3,574	12,336	-15413,1	6008,6	-15160,1	47,001
10	3,869	3,494	23,676	3,429	12,485	-19197,8	7848,0	-14087,4	48,006
11	3,695	3,366	23,898	3,320	12,636	-23423,9	9937,4	-11083,4	48,840
12	3,541	3,250	24,101	3,233	12,784	-28091,5	12343,0	-5635,5	49,552
13	3,402	3,143	24,294	3,158	12,925	-33200,6	15086,2	3037,4	50,187
14	3,192	2,960	16,736	2,868	9,727	-37650,4	18167,1	24326,0	51,224
15	3,014	2,804	13,284	2,652	8,015	-42374,9	21585,6	53329,6	52,216
	3,000	***1,500***	***2,000***	***2,000***	***1,200***				

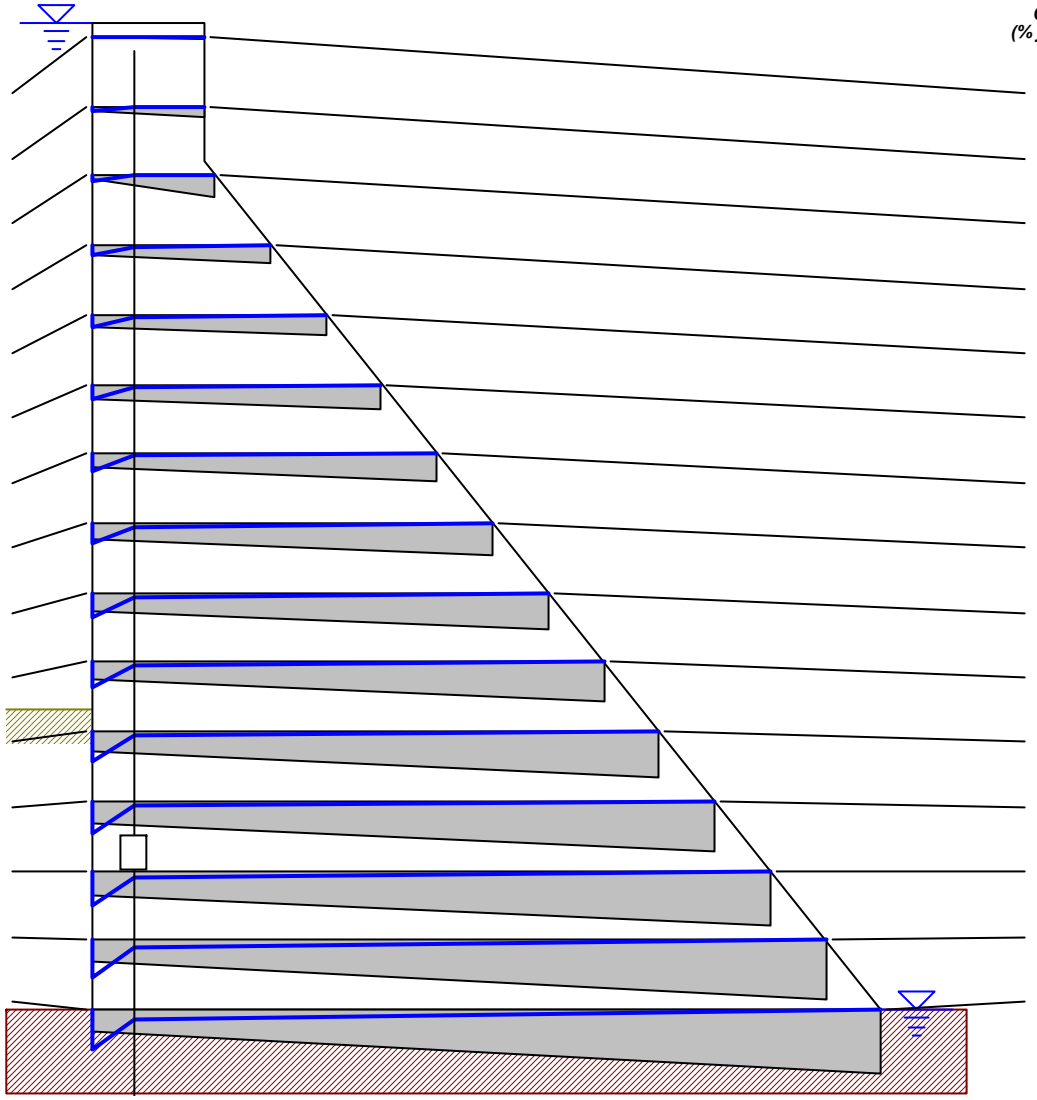
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Flood combination (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-13,581	-13,581	9,810		-23,697	-23,697	0,000
2		-66,769	-66,769	58,860		-184,857	-184,857	0,000
3		-57,588	-57,588	107,910		-362,458	-594,431	0,000
4		-158,838	-158,838	156,960		-304,685	-499,683	0,000
5		-197,597	-197,597	206,010		-341,252	-559,653	0,000
6		-224,054	-224,054	255,060		-403,598	-661,900	0,000
7		-248,367	-248,367	304,110		-475,042	-779,068	0,000
8		-273,039	-273,039	353,160		-550,183	-902,300	0,000
9		-298,664	-298,664	402,210		-626,945	-1028,190	0,000
10		-325,295	-325,295	451,260		-704,435	-1155,273	0,000
11		-352,828	-352,828	500,310		-782,247	-1282,885	0,000
12		-380,633	-380,633	549,360		-860,683	-1411,520	0,000
13		-407,728	-407,728	598,410		-940,503	-1542,425	0,000
14		-394,311	-394,311	647,460		-1019,667	-1672,253	0,000
15		-379,194	-379,194	696,510		-1100,942	-1805,544	0,000

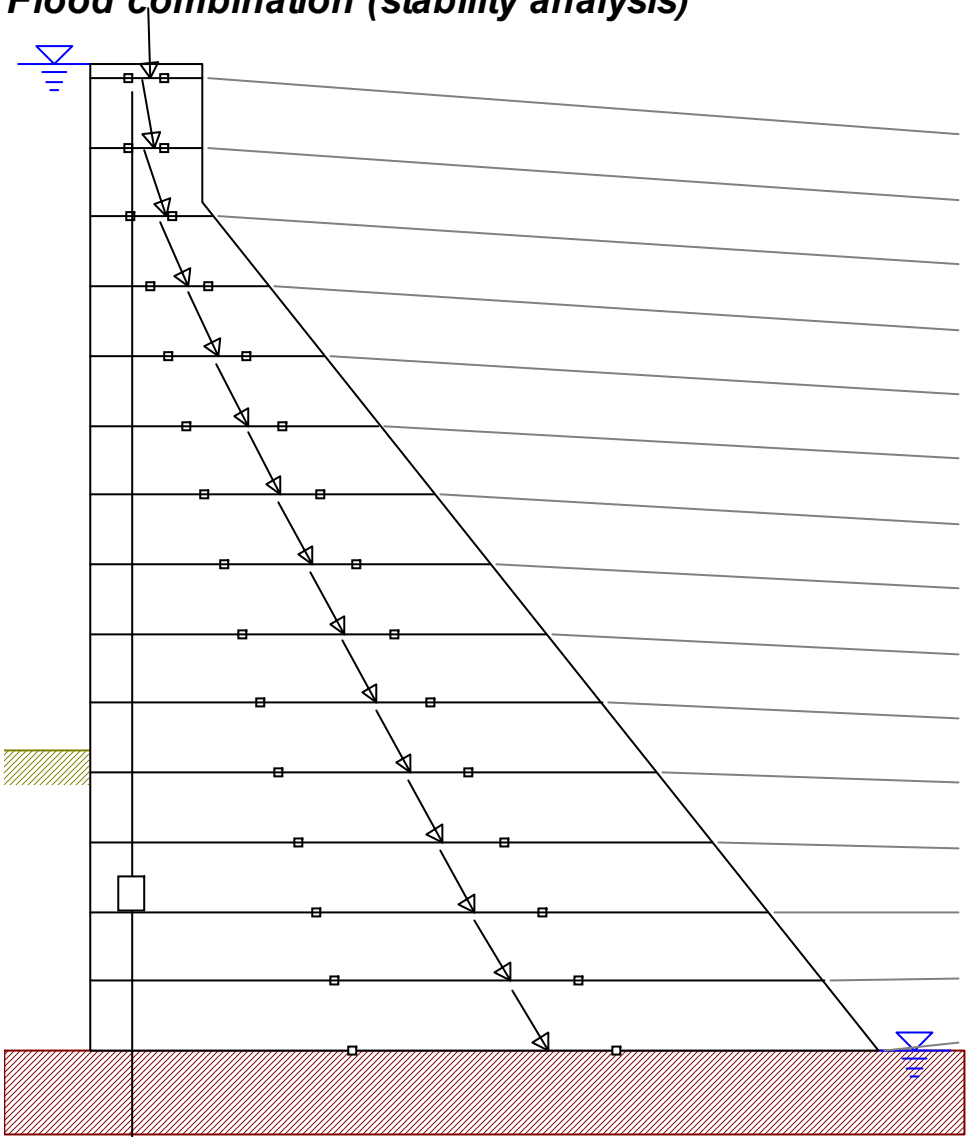


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Flood combination (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	> 100	43,416	7,216	3,572	4,800	-149,1	4,9	54,0	54,523
2	11,765	8,140	22,378	4,021	9,143	-1006,5	176,6	629,8	57,822
3	5,633	4,447	23,850	2,629	8,929	-1848,2	593,5	1967,4	62,097
4	4,189	3,374	21,385	2,602	8,683	-2966,5	1255,7	1991,3	55,244
5	3,610	2,988	21,473	2,528	8,961	-4526,3	2163,1	3378,8	54,443
6	3,313	2,812	22,010	2,482	9,363	-6527,6	3315,8	6473,2	54,768
7	3,139	2,718	22,561	2,457	9,779	-8970,3	4713,7	11617,9	55,222
8	3,026	2,663	23,036	2,445	10,171	-11854,4	6356,9	19156,2	55,611
9	2,948	2,629	23,431	2,439	10,531	-15180,0	8245,3	29431,5	55,911
10	2,891	2,607	23,756	2,438	10,856	-18947,0	10379,0	42787,2	56,137
11	2,847	2,591	24,025	2,439	11,150	-23155,5	12762,6	59569,0	56,305
12	2,800	2,568	24,256	2,440	11,414	-27805,5	15462,6	80290,0	56,445
13	2,751	2,540	24,464	2,440	11,654	-32896,9	18500,1	105731,0	56,586
14	2,630	2,437	17,356	2,296	9,052	-37329,0	21875,3	145282,6	57,371
15	2,524	2,346	13,923	2,181	7,589	-42035,8	25588,1	194044,3	58,127
	2,000	***1,300***	***1,100***	***1,100***	***1,100***				

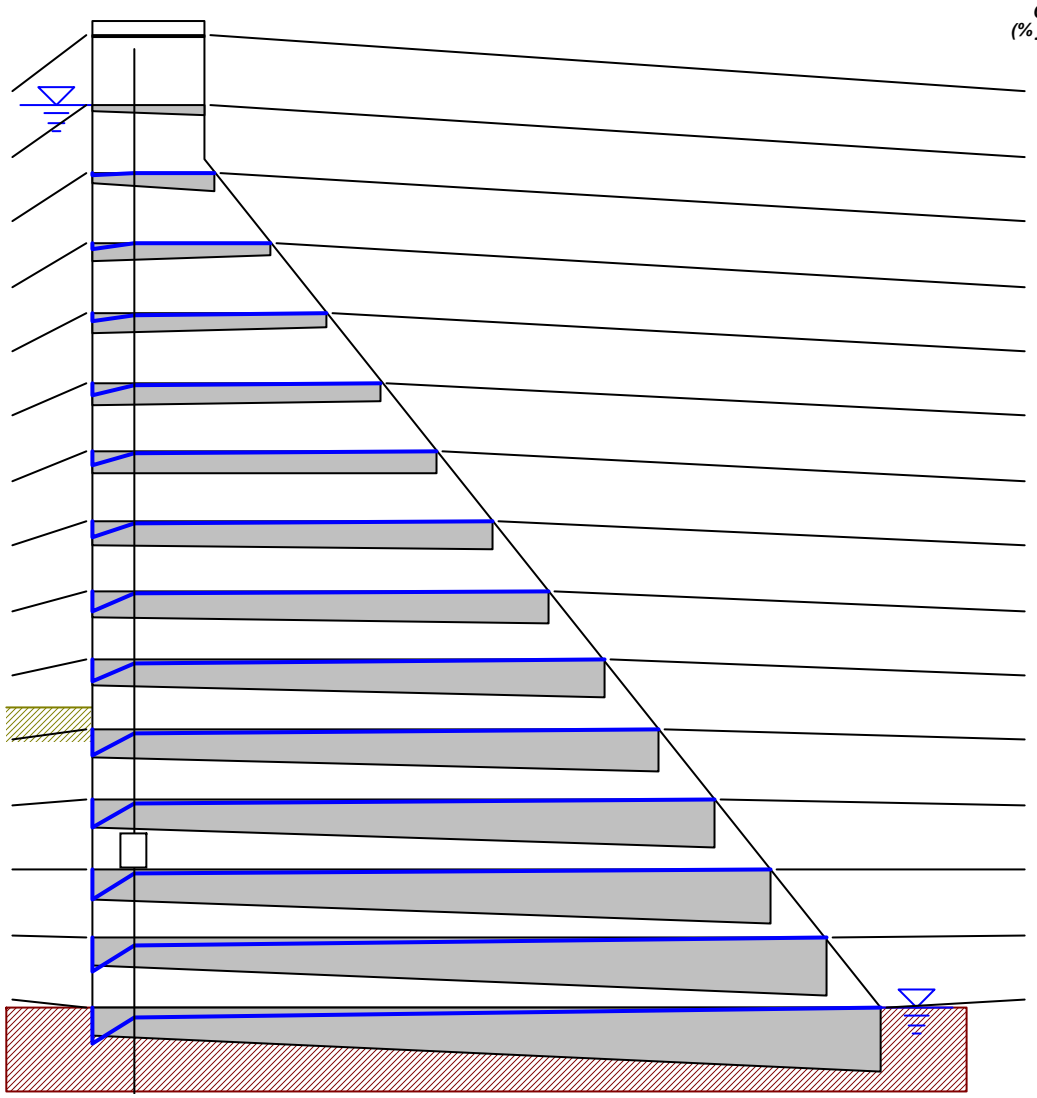
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Peak accelerations (stress analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-24,231	-24,231	0,000		-25,997	-25,997	0,000
2		-118,897	-118,897	0,000		-182,466	-182,466	0,000
3		-174,509	-174,509	49,050		-305,967	-501,786	0,000
4		-300,791	-300,791	98,100		-220,279	-361,258	0,000
5		-347,660	-347,660	147,150		-250,965	-411,582	0,000
6		-375,375	-375,375	196,200		-316,441	-518,963	0,000
7		-397,689	-397,689	245,250		-395,389	-648,439	0,000
8		-418,655	-418,655	294,300		-480,394	-787,846	0,000
9		-439,623	-439,623	343,350		-568,382	-932,146	0,000
10		-461,052	-461,052	392,400		-657,919	-1078,988	0,000
11		-483,062	-483,062	441,450		-748,298	-1227,208	0,000
12		-504,981	-504,981	490,500		-839,806	-1377,282	0,000
13		-525,840	-525,840	539,550		-933,159	-1530,380	0,000
14		-505,952	-505,952	588,600		-1026,171	-1682,921	0,000
15		-484,233	-484,233	637,650		-1121,493	-1839,248	0,000

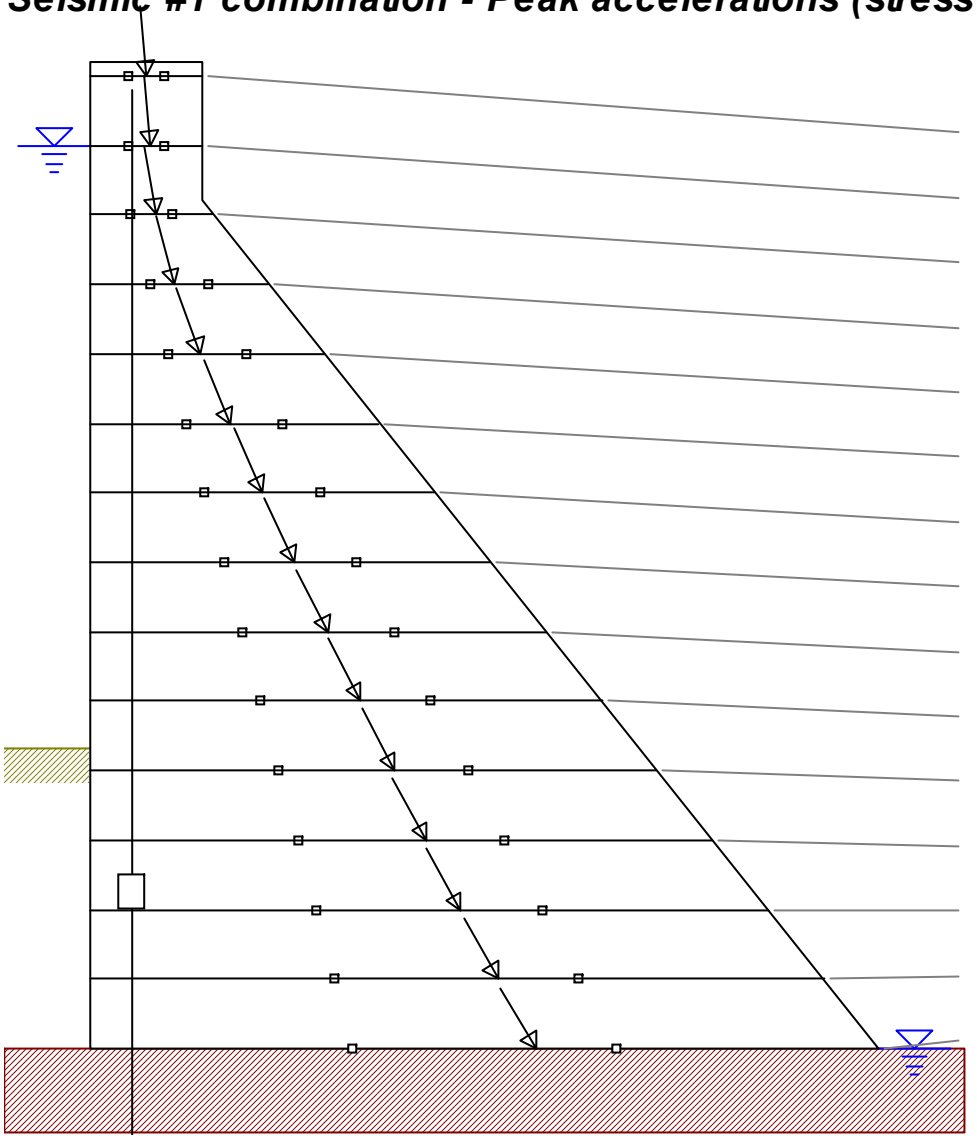


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Peak accelerations (stress analysis) (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	49,213	15,234	> 100	85,333	> 100	-200,9	18,8	9,4	50,586
2	20,897	15,234	> 100	14,222	> 100	-1205,5	113,0	339,0	53,516
3	10,025	8,129	51,522	4,914	20,954	-2114,1	371,4	848,3	54,560
4	6,215	5,115	32,476	4,205	14,819	-3334,9	931,2	-1099,3	47,425
5	4,754	4,005	28,668	3,678	13,381	-5028,5	1793,2	-2274,3	47,308
6	4,044	3,480	27,704	3,350	12,984	-7194,9	2952,6	-2124,8	48,580
7	3,638	3,187	27,513	3,138	12,934	-9834,2	4406,3	-117,9	49,952
8	3,380	3,005	27,560	2,993	13,019	-12946,3	6152,4	4267,4	51,145
9	3,203	2,883	27,680	2,891	13,158	-16531,3	8189,5	11543,7	52,129
10	3,076	2,796	27,814	2,815	13,317	-20589,1	10516,4	22217,1	52,932
11	2,979	2,730	27,944	2,757	13,479	-25119,7	13140,3	36793,5	53,590
12	2,887	2,665	28,070	2,710	13,636	-30123,2	16141,5	56000,6	54,150
13	2,803	2,603	28,200	2,669	13,787	-35599,6	19529,9	80833,8	54,653
14	2,660	2,479	19,370	2,477	10,375	-40448,1	23301,4	120857,4	55,659
15	2,538	2,372	15,334	2,329	8,549	-45602,6	27453,8	171329,3	56,614
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				

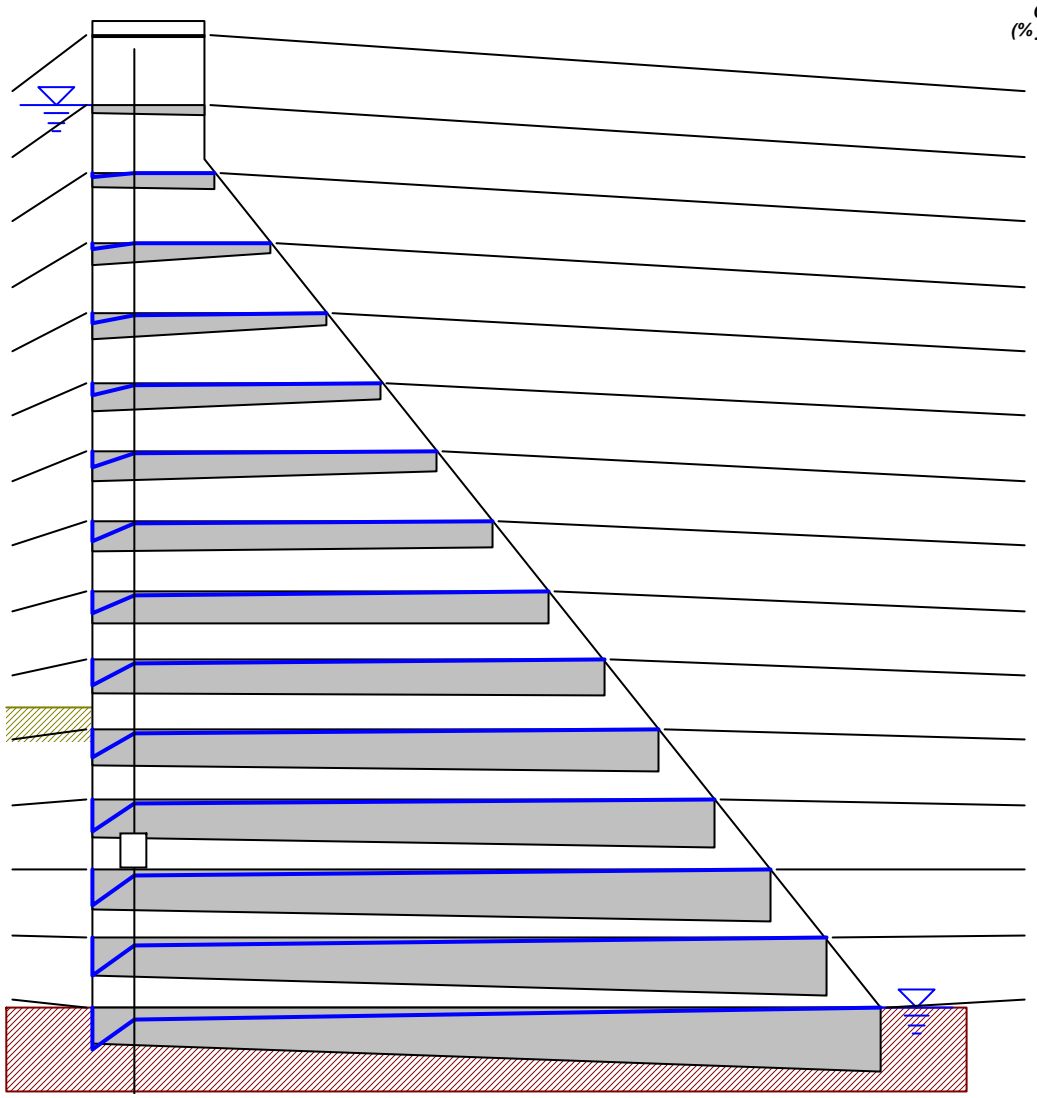
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Sustained accelerations (stability analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-23,887	-23,887	0,000		-24,770	-24,770	0,000
2		-130,081	-130,081	0,000		-161,865	-161,865	0,000
3		-211,991	-211,991	49,050		-252,718	-414,457	0,000
4		-338,061	-338,061	98,100		-165,548	-271,499	0,000
5		-388,120	-388,120	147,150		-190,288	-312,072	0,000
6		-419,938	-419,938	196,200		-248,457	-407,469	0,000
7		-446,575	-446,575	245,250		-319,645	-524,217	0,000
8		-471,854	-471,854	294,300		-396,763	-650,692	0,000
9		-497,043	-497,043	343,350		-476,871	-782,069	0,000
10		-522,575	-522,575	392,400		-558,591	-916,089	0,000
11		-548,566	-548,566	441,450		-641,231	-1051,620	0,000
12		-574,439	-574,439	490,500		-725,000	-1189,000	0,000
13		-599,266	-599,266	539,550		-810,574	-1329,342	0,000
14		-583,340	-583,340	588,600		-895,799	-1469,111	0,000
15		-565,549	-565,549	637,650		-983,353	-1612,699	0,000

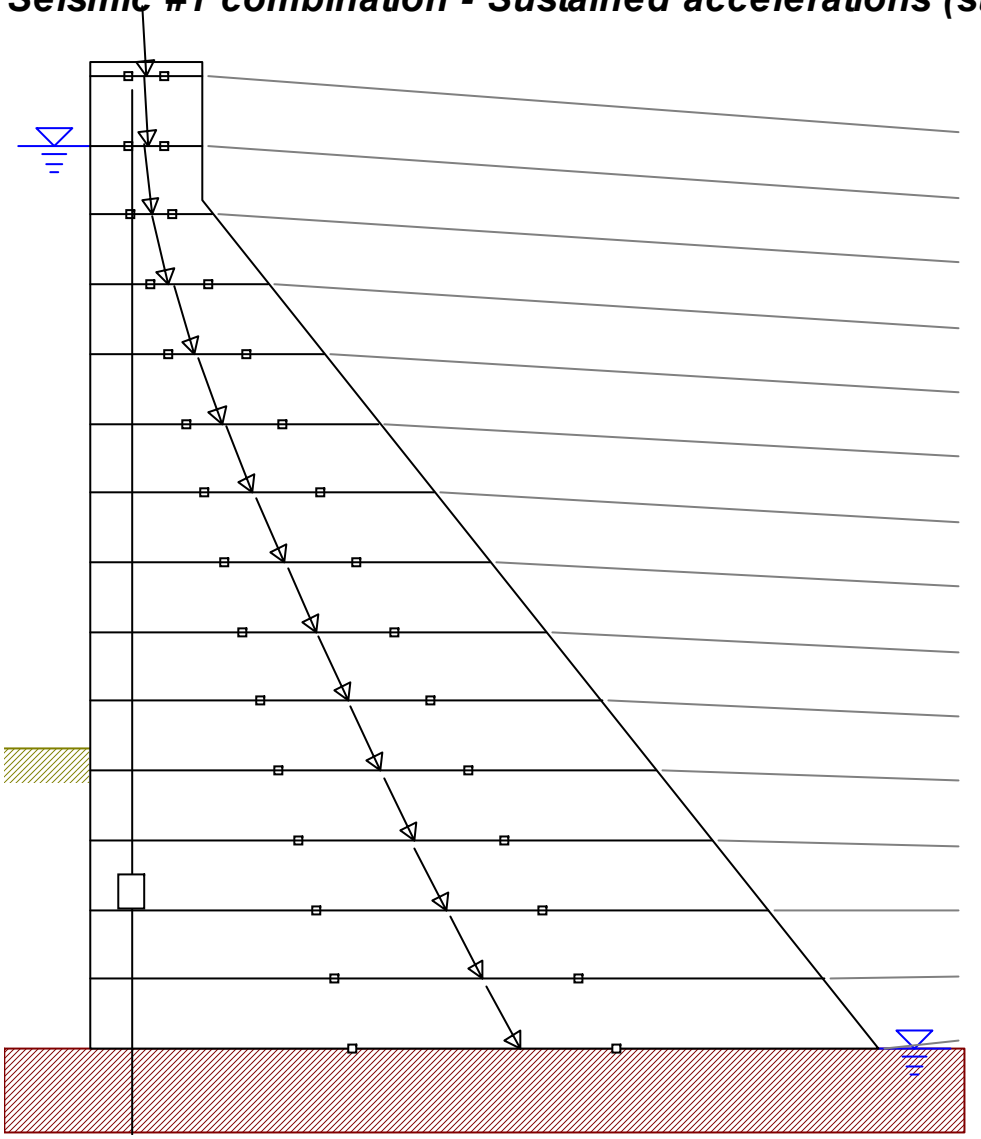


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #1 combination - Sustained accelerations (stability analysis) (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	97,473	29,515	> 100	> 100	> 100	-194,6	9,4	4,7	50,302
2	40,841	29,515	> 100	27,556	> 100	-1167,8	56,5	169,5	51,815
3	14,672	11,822	47,089	6,643	20,299	-2044,7	247,0	262,8	51,461
4	7,916	6,476	29,411	5,147	14,356	-3223,1	710,8	-2355,4	44,291
5	5,719	4,791	26,034	4,304	12,963	-4858,6	1448,4	-4653,0	44,300
6	4,717	4,040	25,283	3,823	12,578	-6951,3	2457,3	-6182,5	45,724
7	4,163	3,632	25,224	3,525	12,530	-9501,1	3736,0	-6505,6	47,239
8	3,817	3,381	25,364	3,326	12,612	-12508,1	5283,5	-5190,2	48,559
9	3,583	3,213	25,554	3,185	12,747	-15972,2	7099,1	-1808,5	49,655
10	3,415	3,094	25,745	3,082	12,901	-19893,5	9182,2	4064,5	50,555
11	3,287	3,004	25,921	3,004	13,057	-24271,9	11538,8	12854,6	51,298
12	3,170	2,919	26,086	2,940	13,210	-29107,4	14242,2	25181,9	51,931
13	3,064	2,838	26,247	2,885	13,356	-34400,1	17308,0	41934,8	52,498
14	2,893	2,690	18,053	2,652	10,051	-39049,3	20734,2	72590,6	53,521
15	2,747	2,562	14,309	2,475	8,282	-43988,8	24519,7	112328,1	54,496
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				

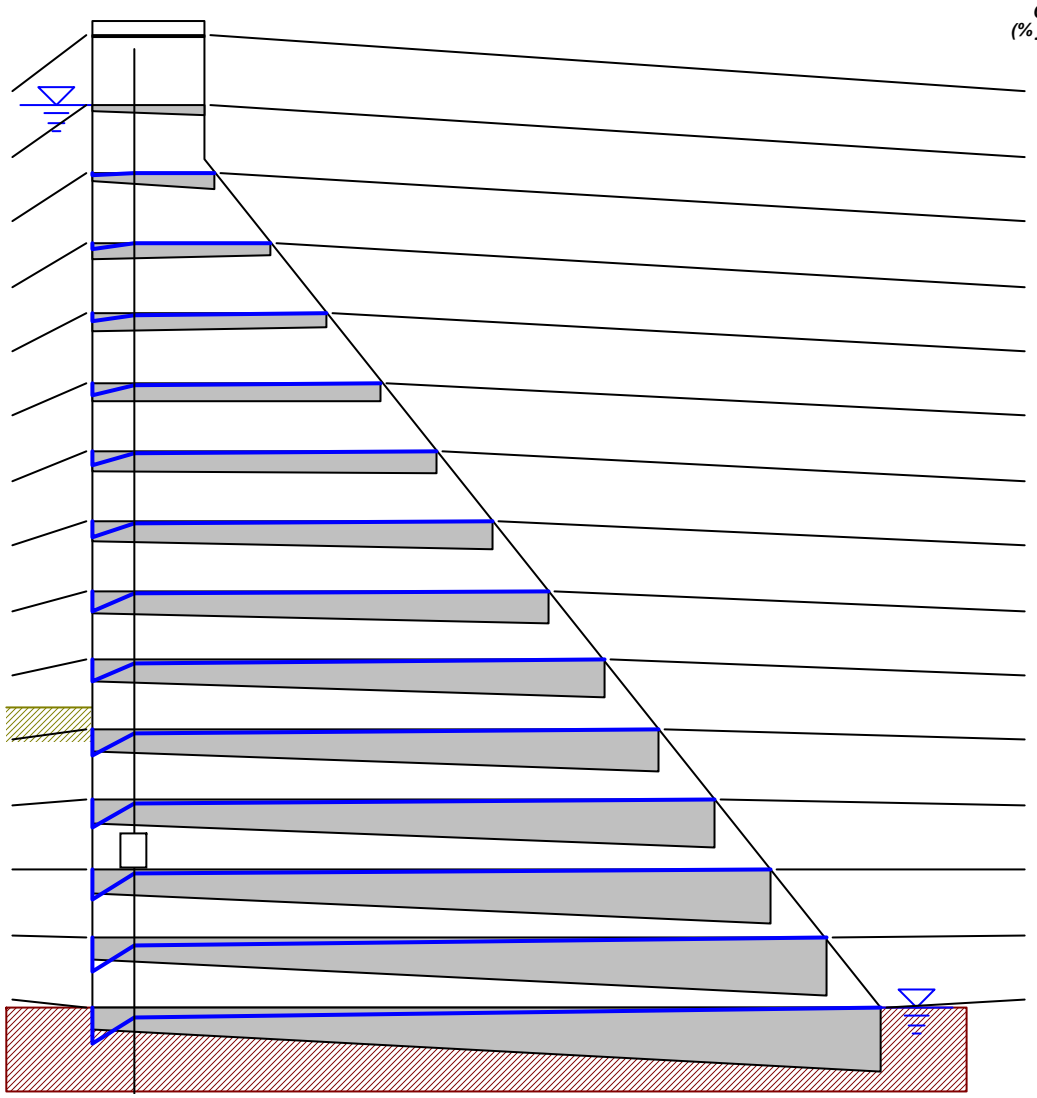
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Peak accelerations (stress analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-22,661	-22,661	0,000		-24,427	-24,427	0,000
2		-109,480	-109,480	0,000		-173,048	-173,048	0,000
3		-154,649	-154,649	49,050		-294,292	-482,639	0,000
4		-268,320	-268,320	98,100		-217,827	-357,236	0,000
5		-306,868	-306,868	147,150		-251,321	-412,166	0,000
6		-327,136	-327,136	196,200		-317,834	-521,248	0,000
7		-342,171	-342,171	245,250		-397,186	-651,385	0,000
8		-355,851	-355,851	294,300		-482,332	-791,024	0,000
9		-369,480	-369,480	343,350		-570,342	-935,362	0,000
10		-383,510	-383,510	392,400		-659,848	-1082,151	0,000
11		-398,063	-398,063	441,450		-750,168	-1230,276	0,000
12		-412,478	-412,478	490,500		-841,608	-1380,237	0,000
13		-425,791	-425,791	539,550		-934,888	-1533,217	0,000
14		-398,322	-398,322	588,600		-1027,829	-1685,639	0,000
15		-368,993	-368,993	637,650		-1123,081	-1841,853	0,000

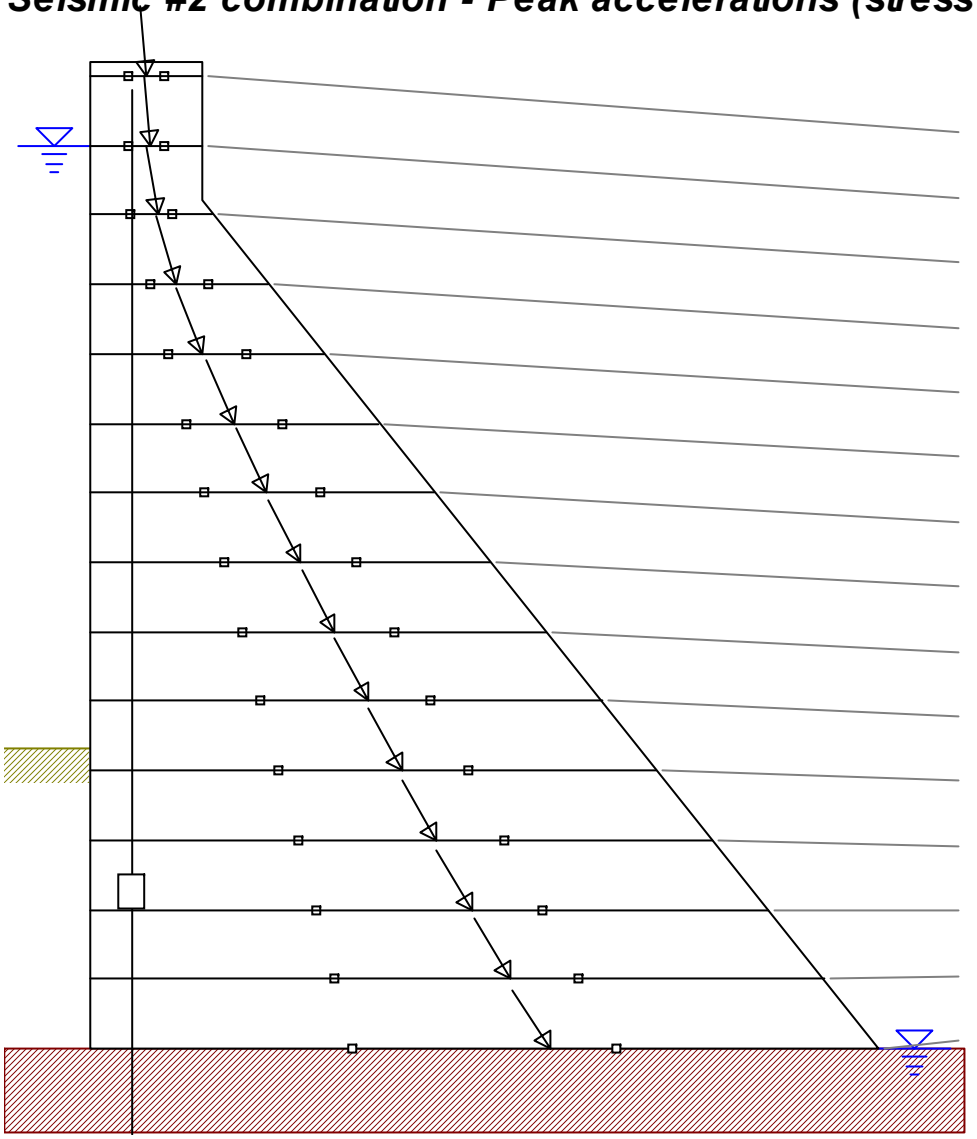


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Peak accelerations (stress analysis) (stability analysis)



Joint #	SSF (peak)	SSF (residual)	OSF (U/S <-)	OSF (-> D/S)	USF	Normal (kN)	Shear (kN)	Moment (kN·m)	Res. Pos. (% joint)
1	48,260	14,281	> 100	80,000	> 100	-188,4	18,8	9,4	50,625
2	19,945	14,281	> 100	13,333	> 100	-1130,1	113,0	339,0	53,750
3	9,491	7,596	48,746	4,607	19,644	-1975,3	371,4	901,2	55,184
4	5,872	4,772	30,889	3,942	13,893	-3111,3	931,2	-689,4	48,269
5	4,484	3,734	27,363	3,448	12,545	-4688,8	1793,2	-1306,5	48,341
6	3,808	3,244	26,501	3,140	12,173	-6707,7	2952,6	-335,3	49,760
7	3,422	2,972	26,354	2,942	12,126	-9168,0	4406,3	2819,7	51,240
8	3,176	2,802	26,425	2,806	12,205	-12069,8	6152,4	8742,4	52,515
9	3,008	2,688	26,559	2,710	12,336	-15413,1	8189,5	18008,0	53,562
10	2,887	2,607	26,702	2,639	12,485	-19197,8	10516,4	31185,7	54,414
11	2,794	2,546	26,838	2,585	12,636	-23423,9	13140,3	48844,0	55,111
12	2,707	2,485	26,968	2,541	12,784	-28091,5	16141,5	71773,3	55,703
13	2,628	2,428	27,102	2,502	12,925	-33200,6	19529,9	101032,1	56,236
14	2,489	2,308	18,621	2,323	9,727	-37650,4	23301,4	146247,0	57,357
15	2,370	2,204	14,745	2,184	8,015	-42374,9	27453,8	202739,2	58,423
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				

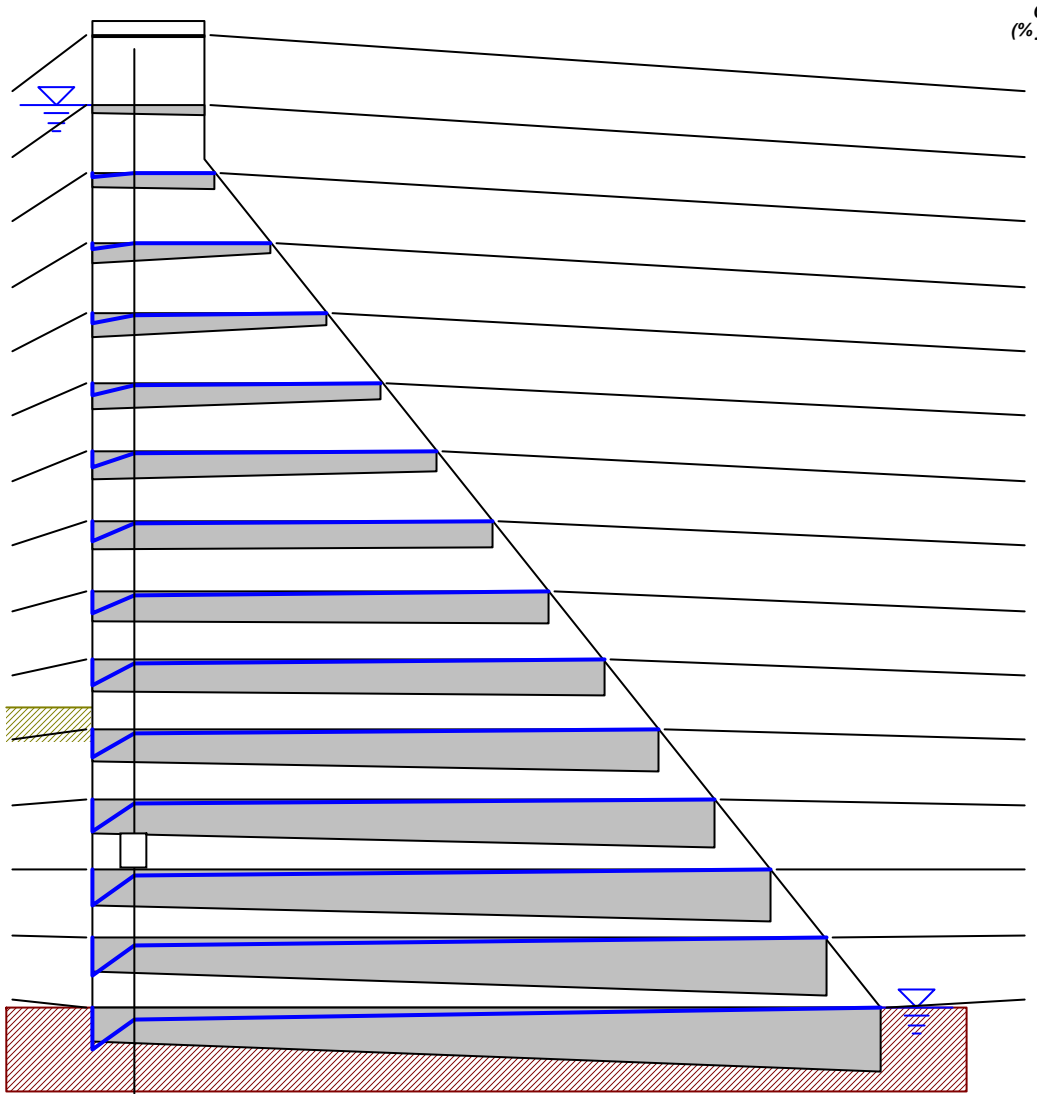
CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Sustained accelerations (stability analysis) (effective stress analysis)

Joint #	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)	Crack (% joint)	Normal (kPa)	Principal (kPa)	Uplift (kPa)
1		-23,103	-23,103	0,000		-23,985	-23,985	0,000
2		-125,372	-125,372	0,000		-157,156	-157,156	0,000
3		-202,061	-202,061	49,050		-246,880	-404,884	0,000
4		-321,825	-321,825	98,100		-164,322	-269,488	0,000
5		-367,723	-367,723	147,150		-190,466	-312,364	0,000
6		-395,817	-395,817	196,200		-249,153	-408,611	0,000
7		-418,815	-418,815	245,250		-320,543	-525,691	0,000
8		-440,450	-440,450	294,300		-397,732	-652,281	0,000
9		-461,970	-461,970	343,350		-477,852	-783,677	0,000
10		-483,802	-483,802	392,400		-559,555	-917,671	0,000
11		-506,065	-506,065	441,450		-642,167	-1053,154	0,000
12		-528,185	-528,185	490,500		-725,901	-1190,477	0,000
13		-549,240	-549,240	539,550		-811,439	-1330,760	0,000
14		-529,523	-529,523	588,600		-896,628	-1470,470	0,000
15		-507,926	-507,926	637,650		-984,147	-1614,002	0,000

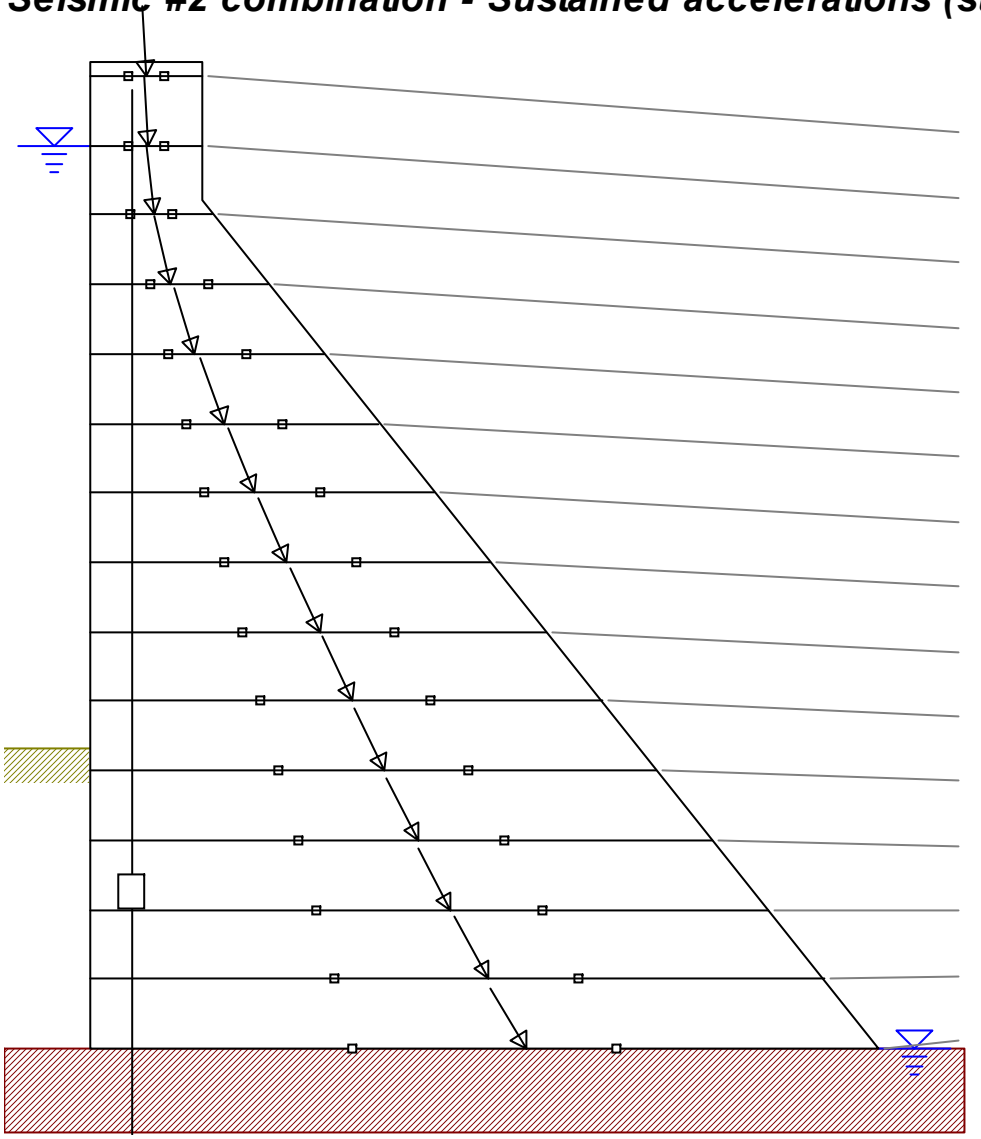


CADAM - Stability drawing

By Martin Leclerc, M. Ing.
NSERC / Hydro-Quebec / Alcan Industrial Chair on Structural Safety of Concrete Dams, École Polytechnique de Montréal, Canada

Project:	TD4	**Dam location:**	FGG	**Analysis performed by:**	
Dam:	Example 1	**Date:**	30/11/2021	**Project engineer:**	Arthur Guillot - Le Goff
Owner:					

Seismic #2 combination - Sustained accelerations (stability analysis) (stability analysis)



Joint #	*SSF (peak)*	*SSF (residual)*	*OSF (U/S <-)*	*OSF (-> D/S)*	*USF*	*Normal (kN)*	*Shear (kN)*	*Moment (kN·m)*	*Res. Pos. (% joint)*
1	96,521	28,563	> 100	> 100	> 100	-188,4	9,4	4,7	50,313
2	39,889	28,563	> 100	26,667	> 100	-1130,1	56,5	169,5	51,875
3	14,271	11,421	45,701	6,429	19,644	-1975,3	247,0	289,2	51,664
4	7,692	6,251	28,618	4,981	13,893	-3111,3	710,8	-2150,4	44,600
5	5,551	4,623	25,381	4,165	12,545	-4688,8	1448,4	-4169,1	44,707
6	4,576	3,898	24,682	3,700	12,173	-6707,7	2457,3	-5287,7	46,210
7	4,036	3,505	24,645	3,411	12,126	-9168,0	3736,0	-5036,7	47,785
8	3,699	3,263	24,797	3,218	12,205	-12069,8	5283,5	-2952,7	49,151
9	3,470	3,101	24,994	3,083	12,336	-15413,1	7099,1	1423,8	50,282
10	3,307	2,986	25,189	2,983	12,485	-19197,8	9182,2	8549,0	51,210
11	3,182	2,899	25,368	2,907	12,636	-23423,9	11538,8	18880,1	51,976
12	3,069	2,817	25,535	2,845	12,784	-28091,5	14242,2	33068,6	52,628
13	2,965	2,739	25,698	2,792	12,925	-33200,6	17308,0	52034,3	53,212
14	2,797	2,593	17,678	2,567	9,727	-37650,4	20734,2	85286,0	54,290
15	2,653	2,468	14,014	2,395	8,015	-42374,9	24519,7	128033,7	55,319
	1,300	***1,000***	***1,100***	***1,100***	***1,100***				