

揚水・排水機場下部工の  
応答変位法による耐震  
検討

レベル2地震動に対して施設の崩壊を防止し、営農の継続のための揚水機能を保持することを確認  
対象の施設の多くが地中部で、地震などの地盤の相対変位に大きく追随されることから、応答変位法を適用

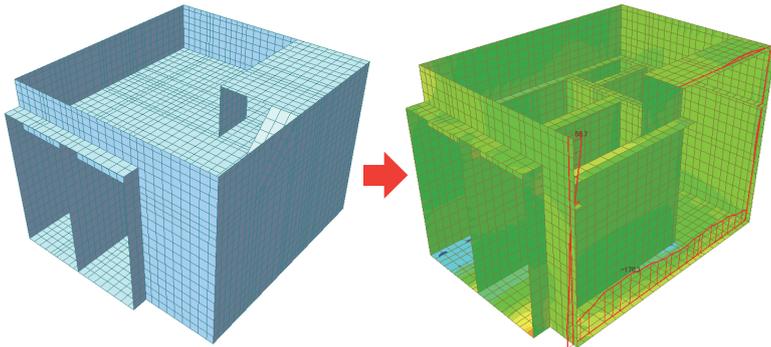
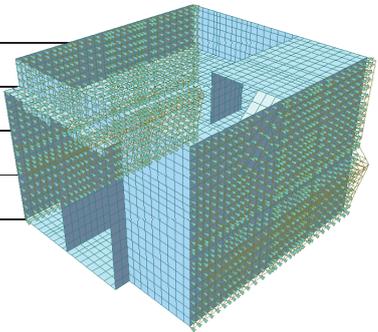
線形静的

解析条件

対象	揚水機場
重要度区分	重要度区分A
要求性能	レベル2地震動に対して施設の崩壊を防止し、 営農の継続のための揚水機能を保持する。
対象地震動	レベル2地震動(流水直角方向) - 躯体に起因する khc=0.32(部材のじん性を見込める場合) - 土に起因する khg=0.70
耐震診断法	解析方法:3次元弾性解析による <b>応答変位法</b> 部材モデル:板要素(壁、床)
安全性の評価	曲げ・せん断耐力照査

載荷荷重

区分	荷重の種類
常時	躯体自重
	建屋荷重
	ポンプ設備主荷重
	群集荷重(その他機器荷重)
静止土圧	
地下水圧、揚圧力	
内水圧、水重	
地震時	躯体慣性力
	建屋水平力
	機器慣性力
	地震時動水圧
	応答変位荷重



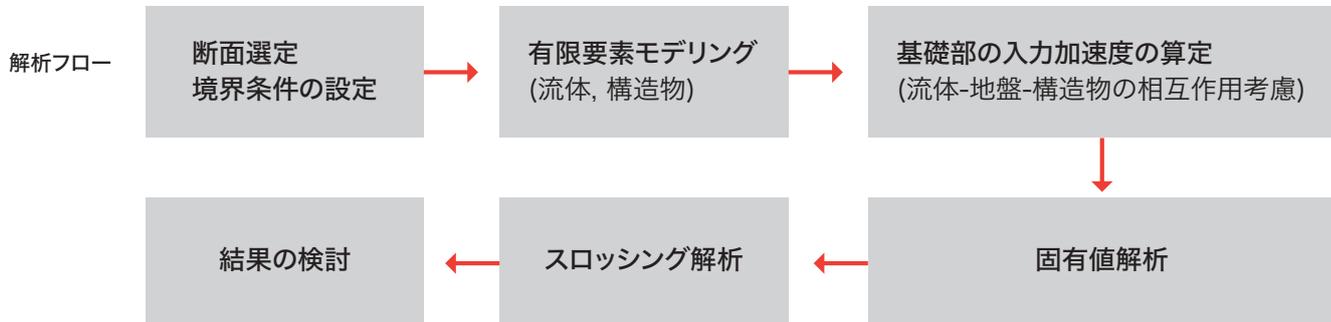
単位幅当たりの断面力分布

単位幅当たりの断面力

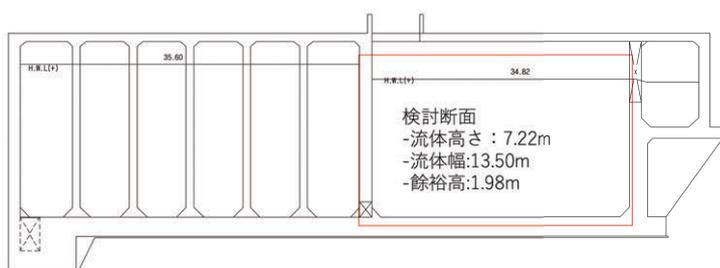
要素	節点	部材	Fxx (kN)	Fyy (kN)	Fzz (kN)	Mxx (kNm)	Myy (kNm)	Mzz (kNm)
1001	1001	1001	-35.808	355.811	166.934	412.283	-100.681	25.913
1001	1001	1001	-86.804	333.858	166.934	382.083	-148.208	70.797
1001	1001	1001	-86.804	337.504	166.934	491.301	-141.007	79.849
1001	1001	1001	8.888	387.504	166.934	432.847	-56.783	69.951
1001	1001	1001	8.888	333.858	166.934	624.236	-61.481	97.737
1002	1002	1002	64.814	-408.978	63.247	414.779	87.014	81.508
1002	1002	1002	64.814	-412.614	63.247	456.029	92.605	91.241
1002	1002	1002	64.814	-416.250	63.247	497.281	98.196	91.974
1002	1002	1002	64.814	-419.886	63.247	538.533	103.787	92.707
1002	1002	1002	64.814	-423.522	63.247	579.785	109.378	93.418
1002	1002	1002	64.814	-427.158	63.247	621.037	114.969	94.129
1002	1002	1002	64.814	-430.794	63.247	662.289	120.560	94.840
1002	1002	1002	64.814	-434.430	63.247	703.541	126.151	95.551
1002	1002	1002	64.814	-438.066	63.247	744.793	131.742	96.262
1002	1002	1002	64.814	-441.702	63.247	786.045	137.333	96.973
1002	1002	1002	64.814	-445.338	63.247	827.297	142.924	97.684
1002	1002	1002	64.814	-448.974	63.247	868.549	148.515	98.395
1002	1002	1002	64.814	-452.610	63.247	909.801	154.106	99.106
1002	1002	1002	64.814	-456.246	63.247	951.053	159.697	99.817
1002	1002	1002	64.814	-459.882	63.247	992.305	165.288	100.528
1002	1002	1002	64.814	-463.518	63.247	1033.557	170.879	101.239
1002	1002	1002	64.814	-467.154	63.247	1074.809	176.470	101.950
1002	1002	1002	64.814	-470.790	63.247	1116.061	182.061	102.661
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1002	1002	1002	64.814	-478.062	63.247	1198.565	193.243	104.083
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1002	1002	1002	64.814	-485.334	63.247	1281.069	204.425	105.505
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1002	1002	1002	64.814	-499.878	63.247	1446.077	226.789	108.349
1002	1002	1002	64.814	-503.514	63.247	1487.329	232.380	109.060
1002	1002	1002	64.814	-507.150	63.247	1528.581	237.971	109.771
1002	1002	1002	64.814	-510.786	63.247	1569.833	243.562	110.482
1002	1002	1002	64.814	-514.422	63.247	1611.085	249.153	111.193
1002	1002	1002	64.814	-518.058	63.247	1652.337	254.744	111.904
1002	1002	1002	64.814	-521.694	63.247	1693.589	260.335	112.615
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1002	1002	1002	64.814	-528.966	63.247	1776.093	271.517	114.037
1002	1002	1002	64.814	-532.602	63.247	1817.345	277.108	114.748
1002	1002	1002	64.814	-536.238	63.247	1858.597	282.699	115.459
1002	1002	1002	64.814	-539.874	63.247	1900.849	288.290	116.170
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1002	1002	1002	64.814	-565.326	63.247	2189.613	327.427	121.147
1002	1002	1002	64.814	-568.962	63.247	2230.865	333.018	121.858
1002	1002	1002	64.814	-572.598	63.247	2272.117	338.609	122.569
1002	1002	1002	64.814	-576.234	63.247	2313.369	344.200	123.280
1002	1002	1002	64.814	-579.870	63.247	2354.621	349.791	123.991
1002	1002	1002	64.814	-583.506	63.247	2395.873	355.382	124.702
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**水槽内水のスロッシング 挙動の検討** 内水のスロッシング作用による越流の予想と構造物の安全性を検討  
対象構造物から2次元の検討断面を決定し、流体解析を通じて内水の地震時の挙動を分析

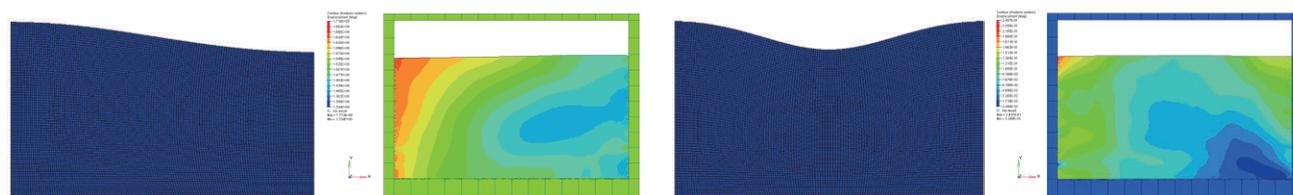
非線形動的



解析断面とモデル



解析結果



人工地震波による流体挙動の分布図

長周期波による流体挙動の分布図