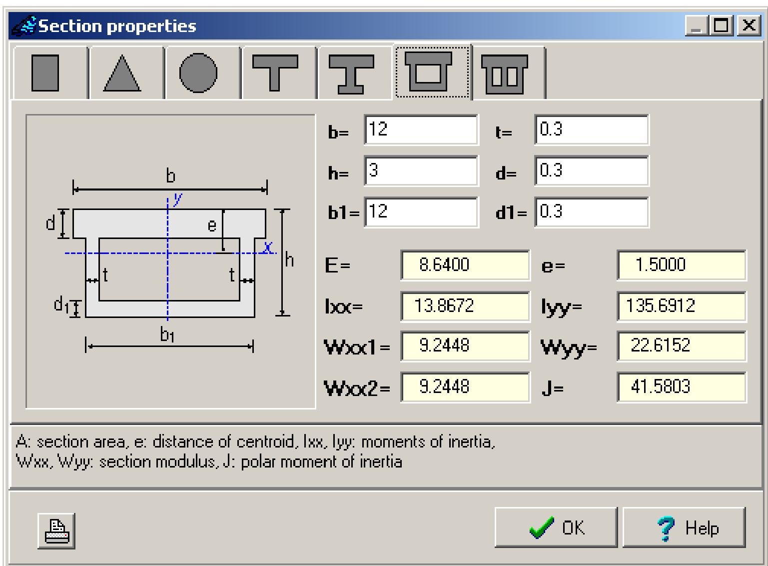
Example 001

Design of a continuous breakwater with 6 pontoons.
Each pontoon is 60 ft long and has a cross section with width B=12ft, height H=3 ft, thickness t=4 in, draft T=2.5 ft. Mooring cables in the middle of each pontoon with a stiffness 3.5 kps/ft. Wave spectrum of Pierson-Moskowitz type with peak wave period Ts=3 sec, and significant wave height Hs=2.5 ft. Short crested waves with directional spectrum $S(f,\theta)= S(f) \cos^{n}(\theta-\theta o)$ with n=2.
From Table 4.1, page 37 of the manual we get for n=2 α=4.5, β=1.9.
From the menu Tools/Cross Section Areas we compute the cross section values.



So we have Iyy=135.7 ft4, Ixx=13.9 ft4, A =8.64 ft2, J=41.58 ft4, Io=Ixx+Iyy=149.60 ft4
Mass (underwater part) mx = my = 12x2.5x0.064/32.2 =0.06 k slug/ft, mt=149.60x0.06/8.64=1.03 k slug ft2/ft (0.064 water specific weight, 32.2 acceleration of gravity)

For the hydrodynamic coefficients we use B=12, T=2.4, and pressing the Generate Values button we get the table according to the table 3.1 page 21 of the manual. (in the values of the added mass the structural mass is added)

We complete the data in the pages of cgFLOAT as shown in the next pages. We use 8 random loading sets for the load simulation. Then we go in the last page Computations and Run Float. The FLOAT computational modulus is running and produces the output file. By pressing Output to Notepad we can see the output.

In the page Graphics you can see and print the graphical output of mode shapes and response values.

It is important to look in the output the displacements, bending moments and shear along the axis.
From the maximum displacement in sway we compute the mooring forces.
In the output we may also look at the response to unit amplitude harmonic waves. (we can see the difference in values due to the short crested waves)

General data

Project File: C:\Programfiler\Runet\cgFLOAT\Examples\Exam1 [Get file] [Save to file]

Project title: Rigid Breakwater 6 pontoons of 60 ft each (section 12x3x0.30)

Units
- (•) Units in Kps and feet
- ( ) Units in kN and meters

Direction of motion)
- [x] Sway
- [x] Heave
- [x] Roll

Run Mode
- [x] Eigenvalue solution
- [x] Frequency response
- [x] Time domain analysis
- [ ] Boat Wake response

Eigenvalue solution

Number of eigenvectors to be plotted	8
Number of eigenvectors to be pinted	8
Maximum iterations in eingenvalue solution	30
Convergrnce tolerance in eigenvalue computation (specify the negative exponent)	-6

Frequency response analysis (chapter 6. page 48)

Lowest spectral period (sec)	1.00
Higest spectral period (sec)	6.00
Number of periods for frequency response computations (max 48)	32

Load simulation (chapter 5. page 44)

Number of simulated random loadings (max 48)	12

Time series analysis (chapter 7, page 52)

Time interval for computations dt (sec)	0.20
Total time of time series To (sec)	100.00
Time interval for random shifts Tsh (sec)	10.00
Wilsons integration theta (default=1.4)	1.40

Participating modes: Sway 12, Heave 12, Roll 12

Boat wake response (chapter 8, page 54)

Significant wave height (ft or m) Hs=	1.00
Significant wave period (sec) Ts=	3.00
Modulation wave period (sec) Tss=	12.00
Boat speed (ft/sec or m/sec) V=	18.00

Load correlation [§ 4, p 35-43]

S.C.F. (spatial correlation factor)
- ( ) Constant S.C.F. (0.60xwave length)
- ( ) Frequency dependent, linear pressure
- ( ) Frequensy dependent, quadratic pressure decrease
- (•) Frequency dependent, exponentially decayed coherence (best choise)

Nodal Load Correlation
- ( ) Uncorrelated loads
- (•) Exponentially decayed coherence (best choise)

Factor alpha for exponentially decayed coherence	$\alpha=$	4.50
Factor beta for exponentially decayed coherence	$\beta=$	1.90
Number for random number generation (any number)	n=	23

Linear pressure decrease

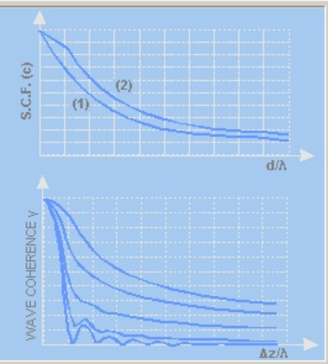
$$scf = \frac{0.6}{(d/\lambda)}\left(1-\frac{0.2}{d/\lambda}\right)$$

Quadratic pressure decrease

$$scf = \frac{0.8}{(d/\lambda)}\left(1-\frac{0.225}{d/\lambda}\right) \quad for\ \frac{d}{\lambda} \geq 0.50$$

Exponentially decayed wave coherence

$$\gamma_w\left(\frac{\Delta z}{\lambda}\right) = \exp\left(-\alpha\left(\frac{\Delta z}{\lambda}\right)^{\beta}\right)$$

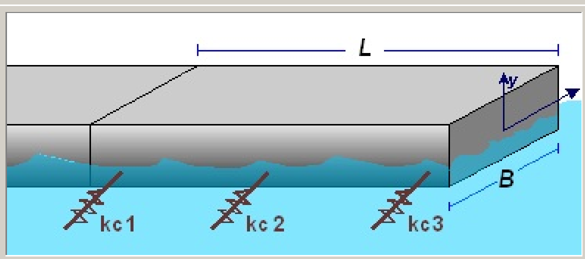


Pontoon properties [§ 2, p. 3-6]

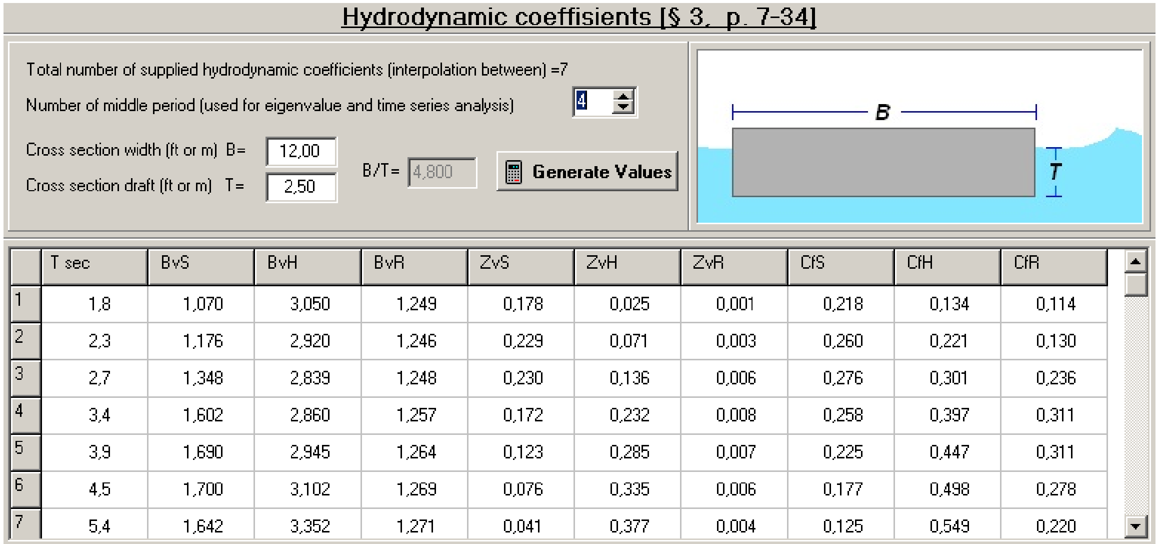
Number of Pontoons: 6

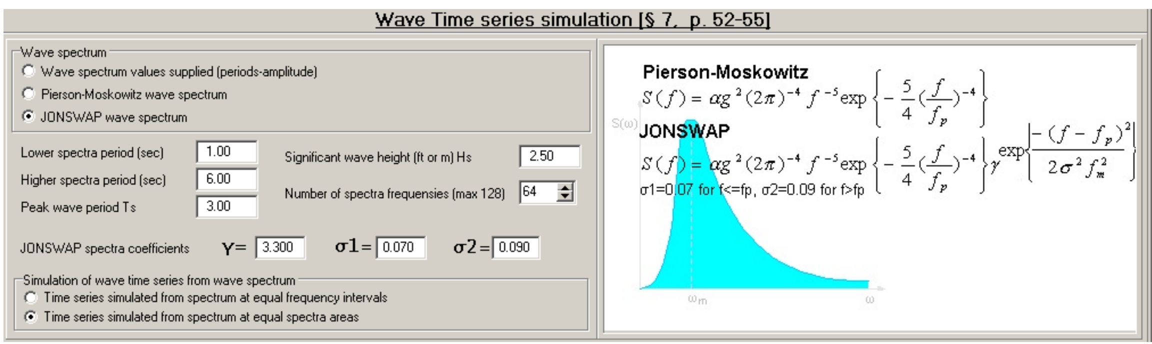
Pontoon similarity
- (•) All pontoons are the same
- ( ) Pontoons are different

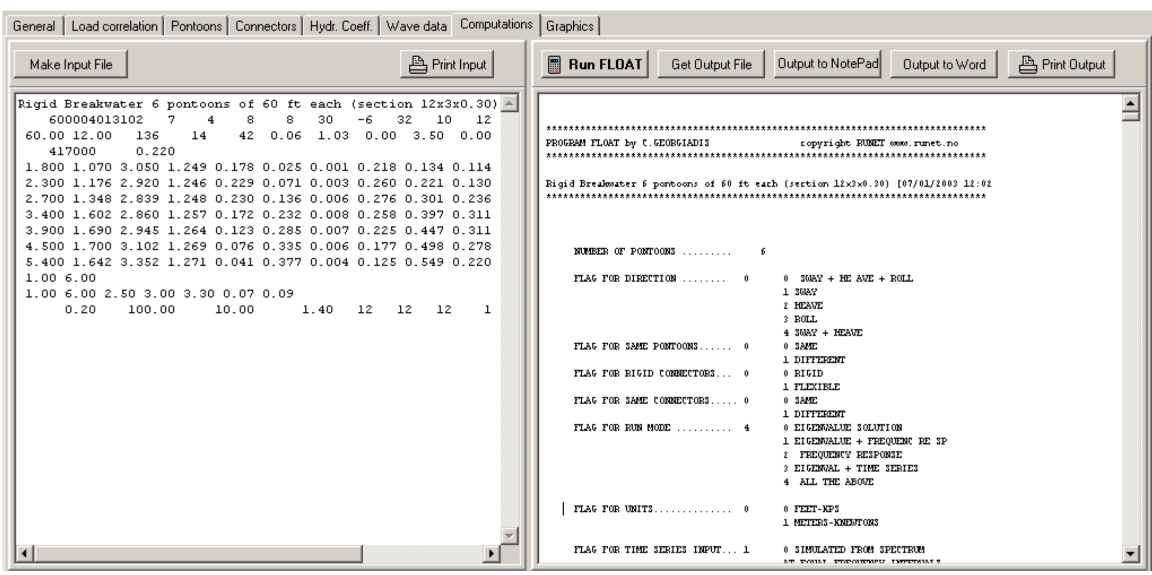
Modulus of Elasticity (kps/ft2 or kN/m2)	E=	417000.00
Poissons Ratio	ν=	0.220

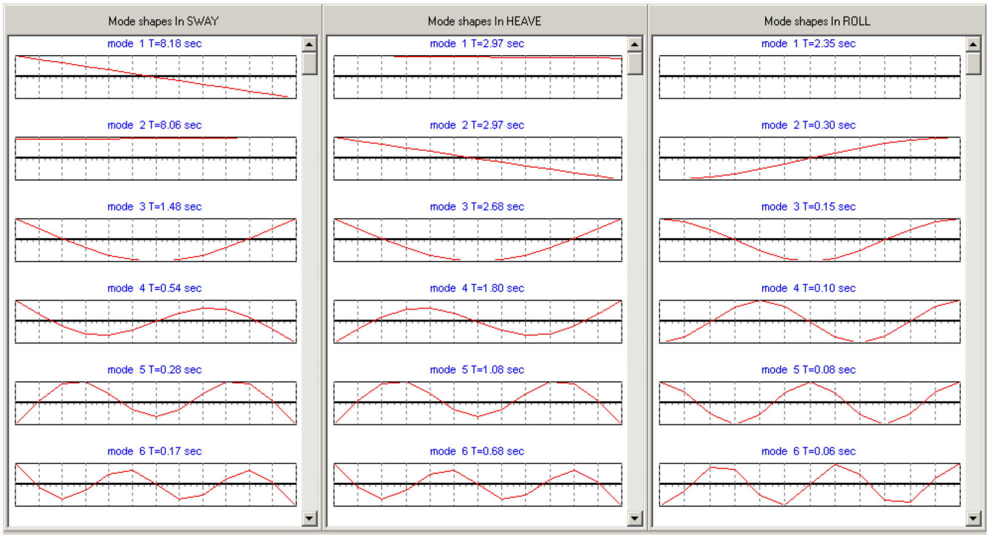


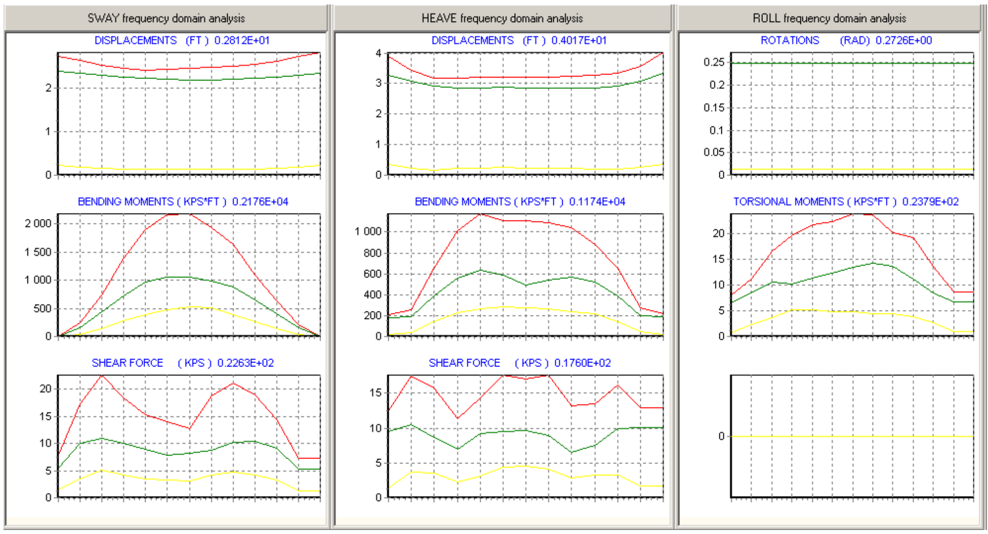
n	L (length)	B (width)	Iyy	Ixx	J	mx,y	mt	Kc1	Kc2	Kc3	s.c.f	exp
	60.000	12.000	135.700	13.900	41.500	0.060	1.030		3.500		1.000	

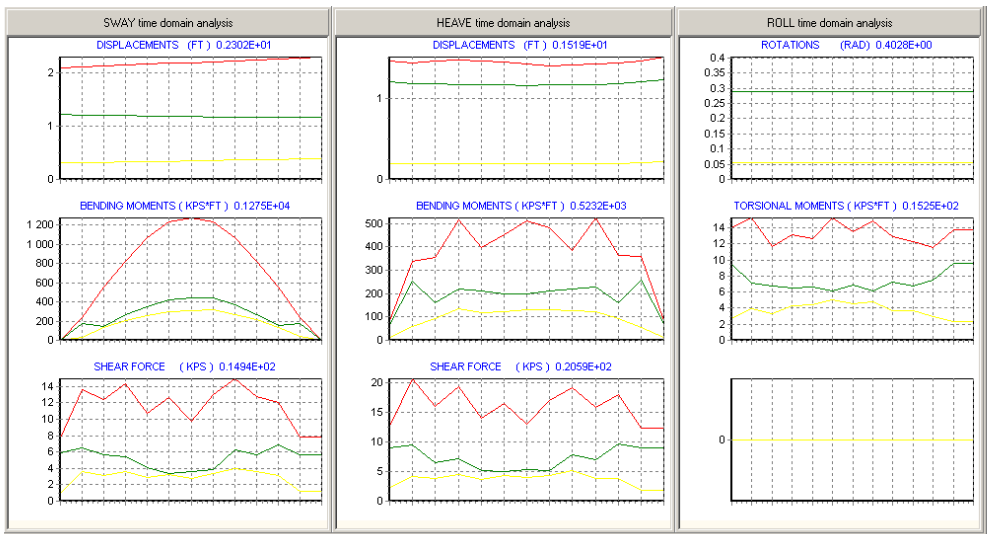

Hydrodynamic coeffisients [§ 3, p. 7-34]
Total number of supplied hydrodynamic coefficients (interpolation between) =7
Number of middle period (used for eigenvalue and time series analysis) 4
Cross section width (ft or m) B= 12,00
Cross section draft (ft or m) T= 2,50
B/T= 4,800
Generate Values
B
T
T sec BvS BvH BvR ZvS ZvH ZvR CfS CfH CfR
1 1,8 1,070 3,050 1,249 0,178 0,025 0,001 0,218 0,134 0,114
2 2,3 1,176 2,920 1,246 0,229 0,071 0,003 0,260 0,221 0,130
3 2,7 1,348 2,839 1,248 0,230 0,136 0,006 0,276 0,301 0,236
4 3,4 1,602 2,860 1,257 0,172 0,232 0,008 0,258 0,397 0,311
5 3,9 1,690 2,945 1,264 0,123 0,285 0,007 0,225 0,447 0,311
6 4,5 1,700 3,102 1,269 0,076 0,335 0,006 0,177 0,498 0,278
7 5,4 1,642 3,352 1,271 0,041 0,377 0,004 0,125 0,549 0,220


Wave Time series simulation [§ 7, p. 52-55]
Wave spectrum
Wave spectrum values supplied (periods-amplitude)
Pierson-Moskowitz wave spectrum
JONSWAP wave spectrum
Lower spectra period (sec) 1.00
Higher spectra period (sec) 6.00
Peak wave period Ts 3.00
Significant wave height (ft or m) Hs 2.50
Number of spectra frequensies (max 128) 64
JONSWAP spectra coefficients γ= 3.300 σ1= 0.070 σ2= 0.090
Simulation of wave time series from wave spectrum
Time series simulated from spectrum at equal frequency intervals
Time series simulated from spectrum at equal spectra areas
Pierson-Moskowitz
$S(f)=\alpha g^2(2\pi)^{-4}f^{-5}\exp\left\{-\frac{5}{4}\left(\frac{f}{f_p}\right)^{-4}\right\}$
JONSWAP
$S(f)=\alpha g^2(2\pi)^{-4}f^{-5}\exp\left\{-\frac{5}{4}\left(\frac{f}{f_p}\right)^{-4}\right\}\gamma^{\exp\left\{\frac{-(f-f_p)^2}{2\sigma^2 f_m^2}\right\}}$
σ1=0.07 for f<=fp, σ2=0.09 for f>fp
S(ω)
ωm
ω


General
Load correlation
Pontoons
Connectors
Hydr. Coeff.
Wave data
Computations
Graphics
Make Input File
Print Input
Rigid Breakwater 6 pontoons of 60 ft each (section 12x3x0.30)
600004013102 7 4 8 8 30 -6 32 10 12
60.00 12.00 136 14 42 0.06 1.03 0.00 3.50 0.00
417000 0.220
1.800 1.070 3.050 1.249 0.178 0.025 0.001 0.218 0.134 0.114
2.300 1.176 2.920 1.246 0.229 0.071 0.003 0.260 0.221 0.130
2.700 1.348 2.839 1.248 0.230 0.136 0.006 0.276 0.301 0.236
3.400 1.602 2.860 1.257 0.172 0.232 0.008 0.258 0.397 0.311
3.900 1.690 2.945 1.264 0.123 0.285 0.007 0.225 0.447 0.311
4.500 1.700 3.102 1.269 0.076 0.335 0.006 0.177 0.498 0.278
5.400 1.642 3.352 1.271 0.041 0.377 0.004 0.125 0.549 0.220
1.00 6.00
1.00 6.00 2.50 3.00 3.30 0.07 0.09
0.20 100.00 10.00 1.40 12 12 12 1
Run FLOAT
Get Output File
Output to NotePad
Output to Word
Print Output
PROGRAM FLOAT by C.GEORGIADIS copyright RUNET www.runet.no
Rigid Breakwater 6 pontoons of 60 ft each (section 12x3x0.30) [07/01/2003 12:02
NUMBER OF PONTOONS 6
FLAG FOR DIRECTION .... 0 0 SWAY + HE AVE + ROLL
1 SWAY
2 HEAVE
3 ROLL
4 SWAY + HEAVE
FLAG FOR SAME PONTOONS...... 0 0 SAME
1 DIFFERENT
FLAG FOR RIGID CONNECTORS... 0 0 RIGID
1 FLEXIBLE
FLAG FOR SAME CONNECTORS..... 0 0 SAME
1 DIFFERENT
FLAG FOR RUN MODE .... 4 0 EIGENVALUE SOLUTION
1 EIGENVALUE + FREQUENC RE SP
2 FREQUENCY RESPONSE
3 EIGENVAL + TIME SERIES
4 ALL THE ABOVE
FLAG FOR UNITS.............. 0 0 FEET-KPS
1 METERS-KNEWTONS
FLAG FOR TIME SERIES INPUT... 1 0 SIMULATED FROM SPECTRUM


Mode shapes In SWAY
mode 1 T=8.18 sec
mode 2 T=8.06 sec
mode 3 T=1.48 sec
mode 4 T=0.54 sec
mode 5 T=0.28 sec
mode 6 T=0.17 sec
Mode shapes In HEAVE
mode 1 T=2.97 sec
mode 2 T=2.97 sec
mode 3 T=2.68 sec
mode 4 T=1.80 sec
mode 5 T=1.08 sec
mode 6 T=0.68 sec
Mode shapes In ROLL
mode 1 T=2.35 sec
mode 2 T=0.30 sec
mode 3 T=0.15 sec
mode 4 T=0.10 sec
mode 5 T=0.08 sec
mode 6 T=0.06 sec


SWAY frequency domain analysis
DISPLACEMENTS (FT) 0.2812E+01
BENDING MOMENTS (KPS*FT) 0.2176E+04
SHEAR FORCE (KPS) 0.2263E+02
HEAVE frequency domain analysis
DISPLACEMENTS (FT) 0.4017E+01
BENDING MOMENTS (KPS*FT) 0.1174E+04
SHEAR FORCE (KPS) 0.1760E+02
ROLL frequency domain analysis
ROTATIONS (RAD) 0.2726E+00
TORSIONAL MOMENTS (KPS*FT) 0.2379E+02


SWAY time domain analysis
DISPLACEMENTS (FT) 0.2302E+01
BENDING MOMENTS (KPS*FT) 0.1275E+04
SHEAR FORCE (KPS) 0.1494E+02
HEAVE time domain analysis
DISPLACEMENTS (FT) 0.1519E+01
BENDING MOMENTS (KPS*FT) 0.5232E+03
SHEAR FORCE (KPS) 0.2059E+02
ROLL time domain analysis
ROTATIONS (RAD) 0.4028E+00
TORSIONAL MOMENTS (KPS*FT) 0.1525E+02