

```

diary on          % begin recording

% FEMA appeal for The Town of Harpswell, Cumberland county, Maine
% TRANSECT ID: YK-06
% calculation by SJH, Ransom Consulting, Inc. 06-Feb-2020
% 100-year wave runup using TAW methodology
% including berm and weighted average with foreshore if necessary
%
% chk nld 20181015
%
% This script assumes that the incident wave conditions provided
% as input in the configuration section below are the
% appropriate values located at the end of the foreshore
% or toe of the slope on which the run-up is being calculated
% the script does not attempt to apply a depth limit or any other
% transformation to the incident wave conditions other than
% conversion of the peak wave period to the spectral mean wave
% as recommended in the references below
%
%
% references:
%
% Van der Meer, J.W., 2002. Technical Report Wave Run-up and
% Wave Overtopping at Dikes. TAW Technical Advisory Committee on
% Flood Defence, The Netherlands.
%
% FEMA. 2007, Atlantic Ocean and Gulf of Mexico Coastal Guidelines Update
%
%
%-----
% CONFIG
%-----
fname='infiles/YK-06sta_ele_include.csv'; % file with station, elevation, include
% third column is 0 for excluded points
imgname='logfiles/YK-06-runup';
SWEL=9.0235; % 100-yr still water level including wave setup.
H0=5.4588; % significant wave height at toe of structure
Tp=9.7161; % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=1; % this may get changed automatically below
gamma_rough=0.75;
gamma_beta=1;
gamma_perm=1;

setupAtToe=0.028035;
maxSetup=0.73082; % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for YK-06'

plotTitle =

Iterative TAW for YK-06

% END CONFIG
%-----

SWEL=SWEL+setupAtToe

SWEL =

          9.051535

SWEL_fore=SWEL+maxSetup

SWEL_fore =

          9.782355

% FIND WAVELENGTH USING DEEPWATER DISPERSION RELATION
% using English units
L0=32.15/(2*pi)*T0^2

L0 =

          399.208418021136

% Find Hb (Munk, 1949)
%Hb=H0/(3.3*(H0/L0)^(1/3))
%Db=-Hb/.78+SWEL; % depth at breaking

% The toe elevation here is only used to determine the average
% structure slope, it is not used to depth limit the wave height.
% Any depth limiting or other modification of the wave height
% to make it consistent with TAW guidance should be performed
% prior to the input of the significant wave height given above.
Ztoe=SWEL-1.5*H0

Ztoe =

```

0.8633349999999999

```
% read the transect
[sta,dep,inc] = textread(fname,'%n%n%n%*[\n]', 'delimiter', ',', 'headerlines', 0);
```

```
% remove unselected points
k=find(inc==0);
sta(k)=[];
dep(k)=[];
```

```
sta_org=sta; % used for plotting purposes
dep_org=dep;
```

```
% initial guess at maximum run-up elevation to estimate slope
Z2=SWEL+1.5*H0
```

```
Z2 =
```

17.239735

```
% determine station at the max runup and -1.5*H0 (i.e. the toe)
top_sta=-999;
toe_sta=-999;
for kk=1:length(sta)-1
    if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1))) % here is the intersection of z2 with profile
        top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
    end
    if ((Ztoe > dep(kk)) & (Ztoe <= dep(kk+1))) % here is the intersection of Ztoe with profile
        toe_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Ztoe)
    end
end
% check to make sure we got them, if not extend the end slopes outward
S=diff(dep)./diff(sta);
if toe_sta== -999
    dy=dep(1)-Ztoe;
    toe_sta=sta(1)-dy/S(1)
end
```

```
toe_sta =
```

20.4222867573847

```
if top_sta== -999
    dy=Z2-dep(end);
    top_sta=sta(end)+dy/S(end)
end
```

```
top_sta =
```

92.4937382297555

```
% just so the reader can tell the values aren't -999 anymore
top_sta
```

```
top_sta =
```

92.4937382297555

```
toe_sta
```

```
toe_sta =
```

20.4222867573847

```
% check for case where the toe of slope is below SWL-1.5*H0
% in this case interpolate setup from the setupAtToe(really setup as first station), and the max setup
% also un-include points seaward of SWL-1.5*H0
```

```
if Ztoe > dep(1)
    dd=SWEL_fore-dep;
    k=find(dd<0,1); % k is index of first land point
    staAtSWL=interp1(dep(k-1:k),sta(k-1:k),SWEL_fore);
    dsta=staAtSWL-sta(1);
    dsetup=maxSetup-setupAtToe;
    dsetdsta=dsetup/dsta;
    setup=setupAtToe+dsetdsta*(toe_sta-sta(1));
    sprintf('-!!- Location of SWEL-1.5*H0 is %4.1f ft landward of toe of slope',dsta)
    sprintf('-!!- Setup is interpolated between setup at toe of slope and max setup')
    sprintf('-!!- setup is adjusted to %4.2f feet',setup)
    SWEL=SWEL-setupAtToe+setup;
    sprintf('-!!- SWEL is adjusted to %4.2f feet',SWEL)
    k=find(dep < SWEL-1.5*H0)
    sta(k)=[];
    dep(k)=[];
else
```

```
    sprintf('-!!- The User has selected a starting point that is %4.2f feet above the elevation of SWEL-1.5H0\n',de
    sprintf('-!!- This may be reasonable for some cases. However the user may want to consider:\n')
    sprintf('-!!- 1) Selecting a starting point that is at or below %4.2f feet elevation, or\n', Ztoe)
    sprintf('-!!- 2) Reducing the incident wave height to a depth limited condition.\n')
```

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end

ans =

-!!- The User has selected a starting point that is 1.98 feet above the elevation of SWEL-1.5H0

ans =

-!!- This may be reasonable for some cases. However the user may want to consider:

ans =

-!!- 1) Selecting a starting point that is at or below 0.86 feet elevation, or

ans =

-!!- 2) Reducing the incident wave height to a depth limited condition.

% now iterate converge on a runup elevation
tol=0.001; % convergence criteria
R2del=999;
R2_new=3*H0; %initial guess
R2=R2_new;
iter=0;
R2_all=[];
topStaAll=[];
Berm_Segs=[];
TAW_ALWAYS_VALID=1;
while(abs(R2del) > tol && iter <= 25)
    iter=iter+1;
    sprintf('!----- STARTING ITERATION %d -----!',iter)
    % elevation of toe of slope
    Ztoe
    % station of toe slope (relative to 0-NAVD88 shoreline)
    toe_sta
    % station of top of slope/extent of 2% run-up
    top_sta
    % elevation of top of slope/extent of 2% run-up
    Z2
    % incident significant wave height
    H0
    % incident spectral peak wave period
    Tp
    % incident spectral mean wave period
    T0

    R2=R2_new
    Z2=R2+SWEL
    % determine slope for this iteration
    top_sta=-999;
    for kk=1:length(sta)-1
        if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1))) % here is the intersection of z2 with profile
            top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
            break;
        end
    end
    if top_sta== -999
        dy=Z2-dep(end);
        top_sta=sta(end)+dy/S(end)
    end

    % get the length of the slope (not accounting for berm)
    Lslope=top_sta-toe_sta

    % loop over profile segments to determine berm factor
    % re-calculate influence of depth of berm based on this run-up elevation
    % check for berm, berm width, berm height
    berm_width=0;
    rdh_sum=0;
    Berm_Segs=[];
    Berm_Heights=[];
    for kk=1:length(sta)-1
        ddep=dep(kk+1)-dep(kk);
        dsta=sta(kk+1)-sta(kk);
        s=ddep/dsta;
        if (s < 1/15) % count it as a berm if slope is flatter than 1:15 (see TAW manual)
            sprintf('Berm Factor Calculation: Iteration %d, Profile Segment: %d',iter,kk)
            berm_width=berm_width+dsta; % tally the width of all berm segments
            % compute the rdh for this segment and weight it by the segment length
            dh=SWEL-(dep(kk)+dep(kk+1))/2
            if dh < 0
                chi=R2;
            else
                chi=2* H0;
            end
            if (dh <= R2 & dh >=-2*H0)

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        rdh=(0.5-0.5*cos(3.14159*dh/chi)) ;
    else
        rdh=1;
    end
    rdh_sum=rdh_sum + rdh * dsta
    Berm_Segs=[Berm_Segs, kk];
    Berm_Heights=[Berm_Heights, (dep(kk)+dep(kk+1))/2];
end
if dep(kk) >= Z2 % jump out of loop if we reached limit of run-up for this iteration
    break
end
end
sprintf('!----- End Berm Factor Calculation, Iter: %d -----!',iter)
berm_width
rB=berm_width/Lslope
if (berm_width > 0)
    rdh_mean=rdh_sum/berm_width
else
    rdh_mean=1
end
gamma_berm=1- rB * (1-rdh_mean)
if gamma_berm > 1
    gamma_berm=1
end
if gamma_berm < 0.6
    gamma_berm =0.6
end
% Iribarren number
slope=(Z2-Ztoe)/(Lslope-berm_width)
Irb=(slope/(sqrt(H0/L0)))
% runup height
gamma_berm
gamma_perm
gamma_beta
gamma_rough
gamma=gamma_berm*gamma_perm*gamma_beta*gamma_rough

% check validity
TAW_VALID=1;
if (Irb*gamma_berm < 0.5 | Irb*gamma_berm > 10 )
    sprintf('!!! - - Iribaren number: %6.2f is outside the valid range (0.5-10), TAW NOT VALID - - !!!\n', Irb)
    TAW_VALID=0;
else
    sprintf('!!! - - Iribaren number: %6.2f is in the valid range (0.5-10), TAW RECOMMENDED - - !!!\n', Irb*gamma_berm)
end
islope=1/slope;
if (slope < 1/8 | slope > 1)
    sprintf('!!! - - slope: 1:%3.1f V:H is outside the valid range (1:8 - 1:1), TAW NOT VALID - - !!!\n', islope)
    TAW_VALID=0;
else
    sprintf('!!! - - slope: 1:%3.1f V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!\n', islope)
end
if TAW_VALID == 0
    TAW_ALWAYS_VALID=0;
end

if (Irb*gamma_berm < 1.8)
    R2_new=gamma*H0*1.77*Irb
else
    R2_new=gamma*H0*(4.3-(1.6/sqrt(Irb)))
end

% check to see if we need to evaluate a shallow foreshore
if berm_width > 0.25 * L0;
    disp('! Berm_width is greater than 1/4 wave length')
    disp('! Runup will be weighted average with foreshore calculation assuming depth limited wave height on
    % do the foreshore calculation
    fore_H0=0.78*(SWEL_fore-min(Berm_Heights))
    % get upper slope
    fore_toe_sta=-999;
    fore_toe_dep=-999;
    for kk=length(dep)-1:-1:1
        ddep=dep(kk+1)-dep(kk);
        dsta=sta(kk+1)-sta(kk);
        s=ddep/dsta;
        if s < 1/15
            break
        end
        fore_toe_sta=sta(kk);
        fore_toe_dep=dep(kk);
        upper_slope=(Z2-fore_toe_dep)/(top_sta-fore_toe_sta)
    end
    fore_Irb=upper_slope/(sqrt(fore_H0/L0));
    fore_gamma=gamma_perm*gamma_beta*gamma_rough;
    if (fore_Irb < 1.8)
        fore_R2=fore_gamma*fore_H0*1.77*fore_Irb;
    else
        fore_R2=fore_gamma*fore_H0*(4.3-(1.6/sqrt(fore_Irb)));
    end
    if berm_width >= L0
        R2_new=fore_R2
        disp('berm is wider than one wavelength, use full shallow foreshore solution');
    else
        w2=(berm_width-0.25*L0)/(0.75*L0)
        w1=1-w2
    end
end

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        R2_new=w2*fore_R2 + w1*R2_new
    end
end % end berm width check

% convergence criterion
R2del=abs(R2-R2_new)
R2_all(iter)=R2_new;

% get the new top station (for plot purposes)
Z2=R2_new+SWEL
top_sta=-999;
for kk=1:length(sta)-1
    if ((Z2 > dep(kk)) & (Z2 <= dep(kk+1))) % here is the intersection of z2 with profile
        top_sta=interp1(dep(kk:kk+1),sta(kk:kk+1),Z2)
        break;
    end
end
if top_sta== -999
    dy=Z2-dep(end);
    top_sta=sta(end)+dy/S(end);
end
topStaAll(iter)=top_sta;

end

ans =

!----- STARTING ITERATION 1 -----!

Ztoe =

    0.863334999999999

toe_sta =

    20.4222867573847

top_sta =

    92.4937382297555

Z2 =

    17.239735

H0 =

    5.4588

Tp =

    9.7161

T0 =

    8.83281818181818

R2 =

    16.3764

Z2 =

    25.427935

top_sta =

    169.59543314501

Lslope =

    149.173146387625

ans =

!----- End Berm Factor Calculation, Iter: 1 -----!

berm_width =

    0

rB =

```

```

0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.164671729428895

Irb =
    1.40821932699039

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.41 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:6.1 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    10.2047416215375

R2del =
    6.17165837846249

Z2 =
    19.2562766215375

ans =
!----- STARTING ITERATION 2 -----!

Ztoe =
    0.863334999999999

toe_sta =
    20.4222867573847

top_sta =
    111.481889091691

```

```

Z2 =
    19.2562766215375

H0 =
    5.4588

Tp =
    9.7161

T0 =
    8.83281818181818

R2 =
    10.2047416215375

Z2 =
    19.2562766215375

top_sta =
    111.481889091691

Lslope =
    91.059602334306

ans =
!----- End Berm Factor Calculation, Iter: 2 -----!

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.201987941414588

Irb =
    1.72733549289557

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =

```

0.75

ans =

!!! - - Iribaren number: 1.73 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =

!!! - - slope: 1:5.0 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =

12.5172351073908

R2del =

2.31249348585333

Z2 =

21.5687701073908

ans =

!----- STARTING ITERATION 3 -----!

Ztoe =

0.863334999999999

toe_sta =

20.4222867573847

top_sta =

133.256780672231

Z2 =

21.5687701073908

H0 =

5.4588

Tp =

9.7161

T0 =

8.83281818181818

R2 =

12.5172351073908

Z2 =

21.5687701073908

top_sta =

133.256780672231

Lslope =

112.834493914846

ans =

!----- End Berm Factor Calculation, Iter: 3 -----!


```

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.183502707275107

Irb =
    1.56925575407555

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.57 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.4 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    11.3717012694865

R2del =
    1.14553383790435

Z2 =
    20.4232362694865

ans =
!----- STARTING ITERATION 4 -----!

Ztoe =
    0.863334999999999

toe_sta =
    20.4222867573847

```

```

top_sta =
    122.470209693847

Z2 =
    20.4232362694865

H0 =
    5.4588

Tp =
    9.7161

T0 =
    8.83281818181818

R2 =
    11.3717012694865

Z2 =
    20.4232362694865

top_sta =
    122.470209693847

Lslope =
    102.047922936462

ans =
!----- End Berm Factor Calculation, Iter: 4 -----!

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.191673683369969

Irb =
    1.63913129675108

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

```

```

gamma_rough =
                                0.75

gamma =
                                0.75

ans =
!!! - - Iribaren number:  1.64 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.2 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
                                11.8780583723906

R2del =
                                0.506357102904133

Z2 =
                                20.9295933723906

ans =
!----- STARTING ITERATION 5 -----!

Ztoe =
                                0.8633349999999999

toe_sta =
                                20.4222867573847

top_sta =
                                127.238167348311

Z2 =
                                20.9295933723906

H0 =
                                5.4588

Tp =
                                9.7161

T0 =
                                8.83281818181818

R2 =
                                11.8780583723906

Z2 =
                                20.9295933723906

top_sta =
                                127.238167348311

Lslope =
                                106.815880590927

```

```

ans =
!----- End Berm Factor Calculation, Iter: 5 -----!

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.187858380807986

Irb =
    1.60650406422771

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.61 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    11.6416232721578

R2del =
    0.236435100232841

Z2 =
    20.6931582721578

ans =
!----- STARTING ITERATION 6 -----!

Ztoe =
    0.863334999999999

```

```
toe_sta =
    20.4222867573847

top_sta =
    125.011848137079

Z2 =
    20.6931582721578

H0 =
    5.4588

Tp =
    9.7161

T0 =
    8.83281818181818

R2 =
    11.6416232721578

Z2 =
    20.6931582721578

top_sta =
    125.011848137079

Lslope =
    104.589561379695

ans =
!----- End Berm Factor Calculation, Iter: 6 -----!

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.189596581251249

Irb =
    1.62136859177519

gamma_berm =
    1

gamma_perm =
    1
```

```

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.62 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    11.7493399183087

R2del =
    0.10771664615088

Z2 =
    20.8008749183087

ans =
!----- STARTING ITERATION 7 -----!

Ztoe =
    0.863334999999999

toe_sta =
    20.4222867573847

top_sta =
    126.026129174282

Z2 =
    20.8008749183087

H0 =
    5.4588

Tp =
    9.7161

T0 =
    8.83281818181818

R2 =
    11.7493399183087

Z2 =
    20.8008749183087

top_sta =
    126.026129174282

```

```

Lslope =
    105.603842416897

ans =
!----- End Berm Factor Calculation, Iter: 7 -----!

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.188795591732357

Irb =
    1.61451878868433

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.61 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    11.6997024297719

R2del =
    0.0496374885367334

Z2 =
    20.7512374297719

ans =

```

!----- STARTING ITERATION 8 -----!

Ztoe =
0.863334999999999

toe_sta =
20.4222867573847

top_sta =
125.558732860376

Z2 =
20.7512374297719

H0 =
5.4588

Tp =
9.7161

T0 =
8.83281818181818

R2 =
11.6997024297719

Z2 =
20.7512374297719

top_sta =
125.558732860376

Lslope =
105.136446102992

ans =
!----- End Berm Factor Calculation, Iter: 8 -----!

berm_width =
0

rB =
0

rdh_mean =
1

gamma_berm =
1

slope =
0.189162780053358

Irb =
1.61765886434924

gamma_berm =
1


```

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.62 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    11.722457167062

R2del =
    0.0227547372900769

Z2 =
    20.773992167062

ans =
!----- STARTING ITERATION 9 -----!

Ztoe =
    0.8633349999999999

toe_sta =
    20.4222867573847

top_sta =
    125.772995923372

Z2 =
    20.773992167062

H0 =
    5.4588

Tp =
    9.7161

T0 =
    8.83281818181818

R2 =
    11.722457167062

Z2 =

```

```

20.773992167062

top_sta =
125.772995923372

Lslope =
105.350709165987

ans =
!----- End Berm Factor Calculation, Iter: 9 -----!

berm_width =
0

rB =
0

rdh_mean =
1

gamma_berm =
1

slope =
0.188994049728621

Irb =
1.61621593722891

gamma_berm =
1

gamma_perm =
1

gamma_beta =
1

gamma_rough =
0.75

gamma =
0.75

ans =
!!! - - Iribaren number: 1.62 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
11.7120009134377

R2del =
0.0104562536242749

Z2 =

```

```

20.7635359134377

ans =
!----- STARTING ITERATION 10 -----!

Ztoe =
0.8633349999999999

toe_sta =
20.4222867573847

top_sta =
125.674537791316

Z2 =
20.7635359134377

H0 =
5.4588

Tp =
9.7161

T0 =
8.83281818181818

R2 =
11.7120009134377

Z2 =
20.7635359134377

top_sta =
125.674537791316

Lslope =
105.252251033931

ans =
!----- End Berm Factor Calculation, Iter: 10 -----!

berm_width =
0

rB =
0

rdh_mean =
1

gamma_berm =
1

slope =
0.189071499354653

Irb =

```

```

1.61687826136083

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.62 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    11.7168004830122

R2del =
    0.00479956957445182

Z2 =
    20.7683354830122

ans =
!----- STARTING ITERATION 11 -----!

Ztoe =
    0.863334999999999

toe_sta =
    20.4222867573847

top_sta =
    125.719731478458

Z2 =
    20.7683354830122

H0 =
    5.4588

Tp =
    9.7161

T0 =
    8.83281818181818

R2 =

```

```

11.7168004830122

Z2 =
20.7683354830122

top_sta =
125.719731478458

Lslope =
105.297444721073

ans =
!----- End Berm Factor Calculation, Iter: 11 -----!

berm_width =
0

rB =
0

rdh_mean =
1

gamma_berm =
1

slope =
0.189035930888346

Irb =
1.61657409135024

gamma_berm =
1

gamma_perm =
1

gamma_beta =
1

gamma_rough =
0.75

gamma =
0.75

ans =
!!! - - Iribaren number: 1.62 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
11.7145962976927

```

```
R2del =
    0.00220418531947786

Z2 =
    20.7661312976927

ans =
!----- STARTING ITERATION 12 -----!

Ztoe =
    0.863334999999999

toe_sta =
    20.4222867573847

top_sta =
    125.698976437785

Z2 =
    20.7661312976927

H0 =
    5.4588

Tp =
    9.7161

T0 =
    8.83281818181818

R2 =
    11.7145962976927

Z2 =
    20.7661312976927

top_sta =
    125.698976437785

Lslope =
    105.2766896804

ans =
!----- End Berm Factor Calculation, Iter: 12 -----!

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
```

```

0.189052261788567

Irb =
    1.61671374792273

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.62 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

R2_new =
    11.7156083270057

R2del =
    0.00101202931299405

Z2 =
    20.7671433270057

ans =
!----- STARTING ITERATION 13 -----!

Ztoe =
    0.863334999999999

toe_sta =
    20.4222867573847

top_sta =
    125.708505904009

Z2 =
    20.7671433270057

H0 =
    5.4588

Tp =
    9.7161

```

```

T0 =
    8.83281818181818

R2 =
    11.7156083270057

Z2 =
    20.7671433270057

top_sta =
    125.708505904009

Lslope =
    105.286219146624

ans =
!----- End Berm Factor Calculation, Iter: 13 -----!

berm_width =
    0

rB =
    0

rdh_mean =
    1

gamma_berm =
    1

slope =
    0.189044762822067

Irb =
    1.61664961918858

gamma_berm =
    1

gamma_perm =
    1

gamma_beta =
    1

gamma_rough =
    0.75

gamma =
    0.75

ans =
!!! - - Iribaren number: 1.62 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!

ans =
!!! - - slope: 1:5.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

```



```
R2_new =  
11.7151436144784
```

```
R2del =  
0.000464712527325162
```

```
Z2 =  
20.7666786144784
```

```
% final 2% runup elevation  
Z2=R2_new+SWEL
```

```
Z2 =  
20.7666786144784
```

```
diary off
```