```
diary on          % begin recording

% FEMA appeal for The Town of Harpswell, Cumberland county, Maine
% TRANSECT ID: YK-06F
% 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='inpfiles/YK-06Fsta_ele_include.csv';   % file with station, elevation, include
                                   % third colunm is 0 for excluded points
imgname='logfiles/YK-06F-runup';
SWEL=9.0235; % 100-yr still water level including wave setup.
H0=5.4882;     % significant wave height at toe of structure
Tp=9.7138;     % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=0.96835;    % this may get changed automatically below
gamma_rough=0.85;
gamma_beta=1;
gamma_perm=1;

setupAtToe=0.02834;
maxSetup=0.62428;    % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for YK-06F'

plotTitle =

Iterative TAW for YK-06F


% END CONFIG
%------------------------------

SWEL=SWEL+setupAtToe

SWEL =

                9.05184

SWEL_fore=SWEL+maxSetup

SWEL_fore =

                9.67612



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

L0 =

        399.019438762892


% 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 consitent with TAW guidance should be performed
% prior to the input of the significant wave height given above.
Ztoe=SWEL-1.5*H0

Ztoe =
```

```
                        0.81954


% 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 =

                  17.28414


% 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 =

          22.726185201595

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

top_sta =

          107.239672801636


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

top_sta =

          107.239672801636

toe_sta

toe_sta =

           22.726185201595




% 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')
```

```
            end

ans =

-!!- The User has selected a starting point that is 2.03 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 0.82 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)
```

```
            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*gam
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', islop
    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
```

```
            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 =

                0.81954


toe_sta =

        22.726185201595


top_sta =

        107.239672801636


Z2 =

                17.28414


H0 =

                5.4882


Tp =

                9.7138


T0 =

        8.83072727272727


R2 =

                16.4646


Z2 =

                25.51644


top_sta =

        191.414519427404


Lslope =

        168.688334225809


ans =

Berm Factor Calculation: Iteration 1, Profile Segment: 11


dh =

                1.70393


rdh_sum =
```

```
                   0.0582905121957862

ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 12

dh =
                         2.17791

rdh_sum =
              0.152325771265479

ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 13

dh =
                         2.65189

rdh_sum =
              0.289565477260354

ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 14

dh =
                         3.12587

rdh_sum =
              0.476675438096609

ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 15

dh =
                         3.59985

rdh_sum =
              0.719405083726818

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

berm_width =
       5

rB =
              0.0296404610487583

rdh_mean =
              0.143881016745364

gamma_berm =
              0.974624238623738

slope =
              0.150877581574815

Irb =
```

```
          1.28649107041569

gamma_berm =

        0.974624238623738

gamma_perm =

    1

gamma_beta =

    1

gamma_rough =

                    0.85

gamma =

        0.828430602830178

ans =
!!! - - Iribaren number:   1.25 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =
!!! - - slope: 1:6.6 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =

        10.3529974157404

R2del =

        6.11160258425958

Z2 =

        19.4048374157404

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

Ztoe =

                0.81954

toe_sta =

          22.726185201595

top_sta =

        128.923695457469

Z2 =

        19.4048374157404

H0 =

                  5.4882

Tp =

                  9.7138

T0 =

        8.83072727272727

R2 =
```

```
          10.3529974157404

Z2 =

          19.4048374157404

top_sta =

          128.923695457469

Lslope =

          106.197510255874

ans =

Berm Factor Calculation: Iteration 2, Profile Segment: 11

dh =

                    1.70393

rdh_sum =

         0.0582905121957862

ans =

Berm Factor Calculation: Iteration 2, Profile Segment: 12

dh =

                    2.17791

rdh_sum =

          0.152325771265479

ans =

Berm Factor Calculation: Iteration 2, Profile Segment: 13

dh =

                    2.65189

rdh_sum =

          0.289565477260354

ans =

Berm Factor Calculation: Iteration 2, Profile Segment: 14

dh =

                    3.12587

rdh_sum =

          0.476675438096609

ans =

Berm Factor Calculation: Iteration 2, Profile Segment: 15

dh =

                    3.59985

rdh_sum =

          0.719405083726818

ans =
```

```
!------- End Berm Factor Calculation, Iter: 2 ---------!

berm_width =

     5

rB =

        0.0470820830728792

rdh_mean =

        0.143881016745364

gamma_berm =

        0.959692134910136

slope =

        0.183653702237814

Irb =

         1.56596391267428

gamma_berm =

        0.959692134910136

gamma_perm =

     1

gamma_beta =

     1

gamma_rough =

                    0.85

gamma =

        0.815738314673616

ans =
!!! - - Iribaren number:   1.50 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 =

        12.4089720609493

R2del =

         2.0559746452089

Z2 =

        21.4608120609493

ans =
!----------------- STARTING ITERATION 3 -----------------!

Ztoe =

                   0.81954

toe_sta =
```

```
          22.726185201595

top_sta =

          149.945931093552

Z2 =

          21.4608120609493

H0 =

                   5.4882

Tp =

                   9.7138

T0 =

          8.83072727272727

R2 =

          12.4089720609493

Z2 =

          21.4608120609493

top_sta =

          149.945931093552

Lslope =

          127.219745891957

ans =

Berm Factor Calculation: Iteration 3, Profile Segment: 11

dh =

                   1.70393

rdh_sum =

        0.0582905121957862

ans =

Berm Factor Calculation: Iteration 3, Profile Segment: 12

dh =

                   2.17791

rdh_sum =

        0.152325771265479

ans =

Berm Factor Calculation: Iteration 3, Profile Segment: 13

dh =

                   2.65189

rdh_sum =

        0.289565477260354

ans =
```

```
Berm Factor Calculation: Iteration 3, Profile Segment: 14

dh =

                  3.12587

rdh_sum =

        0.476675438096609

ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 15

dh =

                  3.59985

rdh_sum =

        0.719405083726818

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

berm_width =

     5

rB =

        0.039302075043023

rdh_mean =

        0.143881016745364

gamma_berm =

         0.96635274747437

slope =

        0.168886556835066

Irb =

         1.44004858119911

gamma_berm =

         0.96635274747437

gamma_perm =

     1

gamma_beta =

     1

gamma_rough =

                  0.85

gamma =

        0.821399835353214

ans =
!!! - - Iribaren number:   1.39 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =
```

```
!!! - - slope: 1:5.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =

         11.4903947996176

R2del =

        0.918577261331743

Z2 =

         20.5422347996176

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

Ztoe =

                  0.81954

toe_sta =

         22.726185201595

top_sta =

         140.553525558462

Z2 =

         20.5422347996176

H0 =

                  5.4882

Tp =

                  9.7138

T0 =

         8.83072727272727

R2 =

         11.4903947996176

Z2 =

         20.5422347996176

top_sta =

         140.553525558462

Lslope =

         117.827340356867

ans =

Berm Factor Calculation: Iteration 4, Profile Segment: 11

dh =

                  1.70393

rdh_sum =

        0.0582905121957862

ans =
```

```
Berm Factor Calculation: Iteration 4, Profile Segment: 12

dh =

                  2.17791

rdh_sum =

        0.152325771265479

ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 13

dh =

                  2.65189

rdh_sum =

        0.289565477260354

ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 14

dh =

                  3.12587

rdh_sum =

        0.476675438096609

ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 15

dh =

                  3.59985

rdh_sum =

        0.719405083726818

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

berm_width =

     5

rB =

        0.0424349729430906

rdh_mean =

        0.143881016745364

gamma_berm =

        0.963670614109523

slope =

        0.174804216223086

Irb =

         1.49050681283954

gamma_berm =

        0.963670614109523
```

```
gamma_perm =

     1

gamma_beta =

     1

gamma_rough =

                    0.85

gamma =

          0.819120021993095

ans =
!!! - - Iribaren number:   1.44 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =
!!! - - slope: 1:5.7 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =
          11.8600003798249

R2del =
          0.369605580207363

Z2 =
          20.9118403798249

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

Ztoe =
                    0.81954

toe_sta =
          22.726185201595

top_sta =
          144.332723720092

Z2 =
          20.9118403798249

H0 =
                    5.4882

Tp =
                    9.7138

T0 =
          8.83072727272727

R2 =
          11.8600003798249

Z2 =
```

```
          20.9118403798249

top_sta =

          144.332723720092

Lslope =

          121.606538518497

ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 11

dh =

                    1.70393

rdh_sum =

        0.0582905121957862

ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 12

dh =

                    2.17791

rdh_sum =

         0.152325771265479

ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 13

dh =

                    2.65189

rdh_sum =

         0.289565477260354

ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 14

dh =

                    3.12587

rdh_sum =

         0.476675438096609

ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 15

dh =

                    3.59985

rdh_sum =

         0.719405083726818

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

berm_width =

     5
```

```
rB =

        0.041116210204762

rdh_mean =

        0.143881016745364

gamma_berm =

        0.964799631924215

slope =

         0.17230852261889

Irb =

         1.46922672932561

gamma_berm =

        0.964799631924215

gamma_perm =

     1

gamma_beta =

     1

gamma_rough =

                    0.85

gamma =

        0.820079687135583

ans =

!!! - - Iribaren number:   1.42 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =

!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =

         11.7043707848237

R2del =

        0.155629595001265

Z2 =

         20.7562107848237

ans =

!---------------- STARTING ITERATION 6 ----------------!

Ztoe =

                 0.81954

toe_sta =

         22.726185201595

top_sta =
```

```
          142.741419067727

Z2 =

          20.7562107848237

H0 =

                   5.4882

Tp =

                   9.7138

T0 =

          8.83072727272727

R2 =

          11.7043707848237

Z2 =

          20.7562107848237

top_sta =

          142.741419067727

Lslope =

          120.015233866132

ans =

Berm Factor Calculation: Iteration 6, Profile Segment: 11

dh =

                   1.70393

rdh_sum =

          0.0582905121957862

ans =

Berm Factor Calculation: Iteration 6, Profile Segment: 12

dh =

                   2.17791

rdh_sum =

          0.152325771265479

ans =

Berm Factor Calculation: Iteration 6, Profile Segment: 13

dh =

                   2.65189

rdh_sum =

          0.289565477260354

ans =

Berm Factor Calculation: Iteration 6, Profile Segment: 14

dh =

                   3.12587
```

```
rdh_sum =

         0.476675438096609

ans =

Berm Factor Calculation: Iteration 6, Profile Segment: 15

dh =

                   3.59985

rdh_sum =

         0.719405083726818

ans =

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

berm_width =

      5

rB =

         0.0416613778012308

rdh_mean =

         0.143881016745364

gamma_berm =

         0.964332903595823

slope =

         0.173339392658439

Irb =

          1.47801667072575

gamma_berm =

         0.964332903595823

gamma_perm =

      1

gamma_beta =

      1

gamma_rough =

                     0.85

gamma =

          0.81968296805645

ans =

!!! - - Iribaren number:   1.43 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =

!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =
```

```
        11.7686985703862

R2del =

      0.0643277855624831

Z2 =

        20.8205385703862

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

Ztoe =

                0.81954

toe_sta =

         22.726185201595

top_sta =

        143.399167386362

Z2 =

        20.8205385703862

H0 =

                 5.4882

Tp =

                 9.7138

T0 =

        8.83072727272727

R2 =

        11.7686985703862

Z2 =

        20.8205385703862

top_sta =

        143.399167386362

Lslope =

        120.672982184767

ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 11

dh =

                1.70393

rdh_sum =

      0.0582905121957862

ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 12

dh =

                2.17791
```

```
rdh_sum =

        0.152325771265479

ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 13

dh =

                 2.65189

rdh_sum =

        0.289565477260354

ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 14

dh =

                 3.12587

rdh_sum =

        0.476675438096609

ans =
Berm Factor Calculation: Iteration 7, Profile Segment: 15

dh =

                 3.59985

rdh_sum =

        0.719405083726818

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

berm_width =

     5

rB =

        0.0414342954775437

rdh_mean =

        0.143881016745364

gamma_berm =

        0.964527313083893

slope =

        0.172909854942947

Irb =

         1.47435412238942

gamma_berm =

        0.964527313083893

gamma_perm =

     1
```

```
gamma_beta =

     1

gamma_rough =

                    0.85

gamma =

        0.819848216121309

ans =
!!! - - Iribaren number:   1.42 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =
!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =

        11.7419022420415

R2del =

        0.026796328344652

Z2 =

        20.7937422420415

ans =
!---------------- STARTING ITERATION 8 -----------------!

Ztoe =

                  0.81954

toe_sta =

         22.726185201595

top_sta =

        143.125176298993

Z2 =

        20.7937422420415

H0 =

                  5.4882

Tp =

                  9.7138

T0 =

        8.83072727272727

R2 =

        11.7419022420415

Z2 =

        20.7937422420415

top_sta =

        143.125176298993
```

```
Lslope =

          120.398991097398

ans =

Berm Factor Calculation: Iteration 8, Profile Segment: 11

dh =

                    1.70393

rdh_sum =

        0.0582905121957862

ans =

Berm Factor Calculation: Iteration 8, Profile Segment: 12

dh =

                    2.17791

rdh_sum =

         0.152325771265479

ans =

Berm Factor Calculation: Iteration 8, Profile Segment: 13

dh =

                    2.65189

rdh_sum =

         0.289565477260354

ans =

Berm Factor Calculation: Iteration 8, Profile Segment: 14

dh =

                    3.12587

rdh_sum =

         0.476675438096609

ans =

Berm Factor Calculation: Iteration 8, Profile Segment: 15

dh =

                    3.59985

rdh_sum =

         0.719405083726818

ans =

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

berm_width =

     5

rB =

        0.0415285871951799
```

```
rdh_mean =

        0.143881016745364

gamma_berm =

        0.964446588154461

slope =

         0.17308818779172

Irb =

         1.47587471686816

gamma_berm =

        0.964446588154461

gamma_perm =

     1

gamma_beta =

     1

gamma_rough =

                    0.85

gamma =

        0.819779599931292

ans =

!!! - - Iribaren number:   1.42 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =

!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =

         11.7530286694215

R2del =

       0.0111264273799865

Z2 =

         20.8048686694215

ans =

!---------------- STARTING ITERATION 9 ----------------!

Ztoe =

                 0.81954

toe_sta =

         22.726185201595

top_sta =

        143.238943450118

Z2 =

         20.8048686694215
```

```
H0 =

                  5.4882

Tp =

                  9.7138

T0 =

        8.83072727272727

R2 =

        11.7530286694215

Z2 =

        20.8048686694215

top_sta =

        143.238943450118

Lslope =

        120.512758248523

ans =

Berm Factor Calculation: Iteration 9, Profile Segment: 11

dh =

                  1.70393

rdh_sum =

        0.0582905121957862

ans =

Berm Factor Calculation: Iteration 9, Profile Segment: 12

dh =

                  2.17791

rdh_sum =

        0.152325771265479

ans =

Berm Factor Calculation: Iteration 9, Profile Segment: 13

dh =

                  2.65189

rdh_sum =

        0.289565477260354

ans =

Berm Factor Calculation: Iteration 9, Profile Segment: 14

dh =

                  3.12587

rdh_sum =

        0.476675438096609
```

```
ans =
Berm Factor Calculation: Iteration 9, Profile Segment: 15

dh =
                  3.59985

rdh_sum =
        0.719405083726818

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

berm_width =
     5

rB =
        0.0414893831380818

rdh_mean =
        0.143881016745364

gamma_berm =
        0.964480151491963

slope =
        0.173014037344892

Irb =
         1.47524245668268

gamma_berm =
        0.964480151491963

gamma_perm =
     1

gamma_beta =
     1

gamma_rough =
                     0.85

gamma =
        0.819808128768169

ans =
!!! - - Iribaren number:   1.42 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =
!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =
          11.748402545563

R2del =
       0.00462612385846839
```

```
Z2 =

          20.800242545563

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

Ztoe =

                    0.81954

toe_sta =

          22.726185201595

top_sta =

        143.191641570175

Z2 =

          20.800242545563

H0 =

                    5.4882

Tp =

                    9.7138

T0 =

        8.83072727272727

R2 =

          11.748402545563

Z2 =

          20.800242545563

top_sta =

        143.191641570175

Lslope =

          120.46545636858

ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 11

dh =

                    1.70393

rdh_sum =

      0.0582905121957862

ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 12

dh =

                    2.17791

rdh_sum =

       0.152325771265479
```

```
ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 13

dh =
                    2.65189

rdh_sum =
         0.289565477260354

ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 14

dh =
                    3.12587

rdh_sum =
         0.476675438096609

ans =
Berm Factor Calculation: Iteration 10, Profile Segment: 15

dh =
                    3.59985

rdh_sum =
         0.719405083726818

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

berm_width =
     5

rB =
         0.0415056743295925

rdh_mean =
         0.143881016745364

gamma_berm =
         0.964466204293651

slope =
         0.173044849723559

Irb =
          1.47550518524447

gamma_berm =
         0.964466204293651

gamma_perm =
     1

gamma_beta =
     1
```

```
gamma_rough =

                    0.85


gamma =

        0.819796273649604


ans =

!!! - - Iribaren number:   1.42 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =

!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =

        11.7503249174496


R2del =

      0.00192237188656819


Z2 =

        20.8021649174496


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

Ztoe =

                 0.81954


toe_sta =

         22.726185201595


top_sta =

        143.211297724434


Z2 =

        20.8021649174496


H0 =

                  5.4882


Tp =

                  9.7138


T0 =

        8.83072727272727


R2 =

        11.7503249174496


Z2 =

        20.8021649174496


top_sta =

        143.211297724434


Lslope =

        120.485112522839
```

```
ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 11

dh =
                  1.70393

rdh_sum =
       0.0582905121957862

ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 12

dh =
                  2.17791

rdh_sum =
        0.152325771265479

ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 13

dh =
                  2.65189

rdh_sum =
        0.289565477260354

ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 14

dh =
                  3.12587

rdh_sum =
        0.476675438096609

ans =
Berm Factor Calculation: Iteration 11, Profile Segment: 15

dh =
                  3.59985

rdh_sum =
        0.719405083726818

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

berm_width =
     5

rB =
       0.0414989030205056

rdh_mean =
        0.143881016745364
```

```
gamma_berm =

         0.964472001339902

slope =

         0.173032042666952

Irb =

          1.47539598304364

gamma_berm =

         0.964472001339902

gamma_perm =

     1

gamma_beta =

     1

gamma_rough =

                    0.85

gamma =

         0.819801201138917

ans =

!!! - - Iribaren number:   1.42 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!


ans =

!!! - - slope: 1:5.8 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!


R2_new =

          11.7495258969969

R2del =

      0.000799020452674881

Z2 =

          20.8013658969969

% final 2% runup elevation
Z2=R2_new+SWEL

Z2 =

          20.8013658969969

diary off
```