```
diary on         % begin recording

% FEMA appeal for The Town of Kennebunkport, York county, Maine
% TRANSECT ID: YK-106
% calculation by SJH, Ransom Consulting, Inc. 02-Apr-2020
% 100-year wave runup using TAW methodology
% including berm and weighted average with foreshore if necessary
%
% chk nld 20200220
%
% 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-106sta_ele_include.csv';   % file with station, elevation, include
                                    % third colunm is 0 for excluded points
imgname='logfiles/YK-106-runup';
SWEL=9.3612;  % 100-yr still water level including wave setup.
H0=2.2239;    % significant wave height at toe of structure
Tp=12.5841;    % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=0.94278;   % this may get changed automatically below
gamma_rough=0.6;
gamma_beta=1;
gamma_perm=1;

setupAtToe=0.66269;
maxSetup=0.86394;   % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for YK-106'

plotTitle =

Iterative TAW for YK-106



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

SWEL=SWEL+setupAtToe

SWEL =

                  10.02389

SWEL_fore=SWEL+maxSetup

SWEL_fore =

                  10.88783



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

L0 =

          669.668791633084


% 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 =

                    6.68804


% 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 =

                   13.35974


% 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

toe_sta =

          172.270232810157


top_sta =

          205.328239137445

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

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

top_sta =

          205.328239137445

toe_sta

toe_sta =

          172.270232810157




% 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',dep(1
   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 =

-!!- Location of SWEL-1.5*H0 is 27.5 ft landward of toe of slope


ans =

-!!- Setup is interpolated between setup at toe of slope and max setup


ans =

-!!-       setup is adjusted to 0.76 feet


ans =

-!!-       SWEL is adjusted to 10.12 feet


k =

     1
     2
     3
     4
     5
     6
     7
     8
     9
    10
    11
    12
    13
    14



% now iterate converge on a runup elevation
tol=0.01;  % 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*gam
   TAW_VALID=0;
else
   sprintf('!!! - - Iribaren number: %6.2f is in the valid range (0.5-10), TAW RECOMMENDED - - !!!\n', Irb*gamma_
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 ber
      % 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 =
                  6.68804
toe_sta =
         172.270232810157
top_sta =
         205.328239137445
Z2 =
                13.35974
H0 =
                  2.2239
Tp =
                  12.5841
T0 =
         11.4400909090909
R2 =
                   6.6717
Z2 =
          16.792859666885
top_sta =
         257.373068974275
Lslope =
         85.1028361641183
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 37
dh =
        -3.53041583311496
rdh_sum =
         0.545744151092099
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 38
```

```
dh =
         -3.59603233311496
rdh_sum =
          1.10684807754562
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 39
dh =
         -3.66164883311496
rdh_sum =
          1.68325345007157
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 40
dh =
         -3.72726583311496
rdh_sum =
          2.27488744847745
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 41
dh =
         -3.79288283311496
rdh_sum =
            2.881662598394
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 42
dh =
         -3.85849983311496
rdh_sum =
          3.50347697161712
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 43
dh =
         -3.92411633311496
rdh_sum =
          4.14021417017599
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 44
dh =
         -3.98973283311496
rdh_sum =
          4.79174366590274
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 45
dh =
         -4.05534983311496
rdh_sum =
          5.45792092105712
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 46
dh =
         -4.12096683311496
rdh_sum =
          6.13858730182598
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 47
dh =
         -4.18658383311496
rdh_sum =
          6.83357034298923
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 48
dh =
         -4.25220033311496
rdh_sum =
          7.54268380562533
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 49
dh =
         -4.31781683311496
rdh_sum =
          8.26572807179969
ans =
!------- End Berm Factor Calculation, Iter: 1 ---------!
berm_width =
    13
rB =
         0.152756366132497
rdh_mean =
         0.635825236292284
gamma_berm =
         0.944369986458848
slope =
         0.140144551926983
Irb =
          2.43191629101195
gamma_berm =
         0.944369986458848
gamma_perm =
     1
gamma_beta =
     1
```

```
gamma_rough =
                    0.6
gamma =
         0.566621991875309
ans =
!!! - - Iribaren number:   2.30 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:7.1 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.12560728910278
R2del =
          2.54609271089722
Z2 =
          14.2467669559878
top_sta =
          218.570720331436
ans =
!----------------- STARTING ITERATION 2 -----------------!
Ztoe =
                    6.68804
toe_sta =
          172.270232810157
top_sta =
          218.570720331436
Z2 =
          14.2467669559878
H0 =
                     2.2239
Tp =
                    12.5841
T0 =
          11.4400909090909
R2 =
          4.12560728910278
Z2 =
          14.2467669559878
top_sta =
          218.570720331436
Lslope =
          46.3004875212792
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 37
dh =
         -3.53041583311496
rdh_sum =
         0.949518231292898
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 38
dh =
         -3.59603233311496
rdh_sum =
          1.90941029675155
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 39
dh =
         -3.66164883311496
rdh_sum =
           2.8785282676531
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 40
dh =
         -3.72726583311496
rdh_sum =
          3.85570124351448
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 41
dh =
         -3.79288283311496
rdh_sum =
          4.83973814287964
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 42
dh =
         -3.85849983311496
rdh_sum =
          5.82943075110932
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 43
dh =
         -3.92411633311496
rdh_sum =
          6.82355670713583
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 44
dh =
         -3.98973283311496
rdh_sum =
          7.82088263160731
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 45
```

```
dh =
         -4.05534983311496
rdh_sum =
          8.82016716796591
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 46
dh =
         -4.12096683311496
rdh_sum =
          9.82016404162643
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 47
dh =
         -4.18658383311496
rdh_sum =
          10.8196251999236
ans =
!------- End Berm Factor Calculation, Iter: 2 ---------!
berm_width =
    11
rB =
         0.237578491909929
rdh_mean =
         0.983602290902147
gamma_berm =
         0.996104257001754
slope =
         0.214125285137533
Irb =
          3.71569755715408
gamma_berm =
         0.996104257001754
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                      0.6
gamma =
         0.597662554201053
ans =
!!! - - Iribaren number:   3.70 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.7 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.61206673401333
R2del =
         0.486459444910555
Z2 =
          14.7332264008984
ans =
!----------------- STARTING ITERATION 3 -----------------!
Ztoe =
                    6.68804
toe_sta =
          172.270232810157
top_sta =
          225.984354677879
Z2 =
          14.7332264008984
H0 =
                     2.2239
Tp =
                    12.5841
T0 =
          11.4400909090909
R2 =
          4.61206673401333
Z2 =
          14.7332264008984
top_sta =
          225.984354677879
Lslope =
          53.7141218677221
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 37
dh =
         -3.53041583311496
rdh_sum =
         0.870315245154172
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 38
dh =
         -3.59603233311496
rdh_sum =
          1.75527150410681
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 39
dh =
         -3.66164883311496
```

```
rdh_sum =
          2.65409987120616
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 40
dh =
         -3.72726583311496
rdh_sum =
          3.56600382940036
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 41
dh =
         -3.79288283311496
rdh_sum =
          4.49016063558538
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 42
dh =
         -3.85849983311496
rdh_sum =
          5.42572307263599
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 43
dh =
         -3.92411633311496
rdh_sum =
          6.37182106473792
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 44
dh =
         -3.98973283311496
rdh_sum =
          7.32756358269138
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 45
dh =
         -4.05534983311496
rdh_sum =
           8.2920403965119
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 46
dh =
         -4.12096683311496
rdh_sum =
          9.26432375329019
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 47
dh =
         -4.18658383311496
rdh_sum =
          10.2434703072117
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 48
dh =
         -4.25220033311496
rdh_sum =
          11.2285229624827
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 49
dh =
         -4.31781683311496
rdh_sum =
          12.2185128824641
ans =
!------- End Berm Factor Calculation, Iter: 3 ---------!
berm_width =
    13
rB =
         0.242022014843958
rdh_mean =
          0.93988560634339
gamma_berm =
         0.985450993326104
slope =
         0.197601864705242
Irb =
          3.42896807120544
gamma_berm =
         0.985450993326104
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.6
gamma =
         0.591270595995663
ans =
!!! - - Iribaren number:   3.38 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.1 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
```

```
R2_new =
          4.51802392308553
R2del =
         0.0940428109277986
Z2 =
          14.6391835899706
ans =
!----------------- STARTING ITERATION 4 -----------------!
Ztoe =
                    6.68804
toe_sta =
          172.270232810157
top_sta =
           224.55114665362
Z2 =
          14.6391835899706
H0 =
                     2.2239
Tp =
                    12.5841
T0 =
          11.4400909090909
R2 =
          4.51802392308553
Z2 =
          14.6391835899706
top_sta =
           224.55114665362
Lslope =
          52.2809138434632
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 37
dh =
         -3.53041583311496
rdh_sum =
         0.886661042345764
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 38
dh =
         -3.59603233311496
rdh_sum =
          1.78737847312912
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 39
dh =
         -3.66164883311496
rdh_sum =
          2.70131824448724
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 40
dh =
         -3.72726583311496
rdh_sum =
          3.62761887859615
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 41
dh =
         -3.79288283311496
rdh_sum =
          4.56539306553805
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 42
dh =
         -3.85849983311496
rdh_sum =
          5.51372961413297
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 43
dh =
         -3.92411633311496
rdh_sum =
          6.47169527874202
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 44
dh =
         -3.98973283311496
rdh_sum =
          7.43833685579963
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 45
dh =
         -4.05534983311496
rdh_sum =
          8.41268313878004
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 46
dh =
         -4.12096683311496
rdh_sum =
          9.39374681467531
```

```
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 47
dh =
         -4.18658383311496
rdh_sum =
          10.3805265887733
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 48
dh =
         -4.25220033311496
rdh_sum =
          11.3720092368213
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 49
dh =
         -4.31781683311496
rdh_sum =
          12.3671717934558
ans =
!------- End Berm Factor Calculation, Iter: 4 ---------!
berm_width =
    13
rB =
         0.248656709385837
rdh_mean =
         0.951320907188907
gamma_berm =
         0.987895616965706
slope =
         0.202417479940929
Irb =
          3.51253302597452
gamma_berm =
         0.987895616965706
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.6
gamma =
         0.592737370179424
ans =
!!! - - Iribaren number:   3.47 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          4.54286185909809
R2del =
        0.0248379360125632
Z2 =
          14.6640215259831
ans =
!----------------- STARTING ITERATION 5 -----------------!
Ztoe =
                    6.68804
toe_sta =
          172.270232810157
top_sta =
          224.929675632582
Z2 =
          14.6640215259831
H0 =
                     2.2239
Tp =
                    12.5841
T0 =
          11.4400909090909
R2 =
          4.54286185909809
Z2 =
          14.6640215259831
top_sta =
          224.929675632582
Lslope =
          52.6594428224254
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 37
dh =
         -3.53041583311496
rdh_sum =
         0.882371522388302
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 38
dh =
         -3.59603233311496
rdh_sum =
          1.77896334649868
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 39
```

```
dh =
         -3.66164883311496
rdh_sum =
          2.68895901158635
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 40
dh =
         -3.72726583311496
rdh_sum =
          3.61151455493854
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 41
dh =
         -3.79288283311496
rdh_sum =
          4.54576005123253
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 42
dh =
         -3.85849983311496
rdh_sum =
          5.49080150875659
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 43
dh =
         -3.92411633311496
rdh_sum =
          6.44572263815255
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 44
dh =
         -3.98973283311496
rdh_sum =
          7.40958689655306
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 45
dh =
         -4.05534983311496
rdh_sum =
          8.38143938712393
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 46
dh =
         -4.12096683311496
rdh_sum =
          9.36030869572424
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 47
dh =
         -4.18658383311496
rdh_sum =
           10.34520896252
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 48
dh =
         -4.25220033311496
rdh_sum =
          11.3351418770797
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 49
dh =
         -4.31781683311496
rdh_sum =
          12.3290988180249
ans =
!------- End Berm Factor Calculation, Iter: 5 ---------!
berm_width =
    13
rB =
         0.246869304026587
rdh_mean =
         0.948392216771146
gamma_berm =
         0.987259622471938
slope =
         0.201111789736822
Irb =
          3.48987549676827
gamma_berm =
         0.987259622471938
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.6
gamma =
         0.592355773483163
ans =
!!! - - Iribaren number:   3.45 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 =
          4.53629239466394
R2del =
       0.00656946443415762
Z2 =
           14.657452061549
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =
           14.657452061549
diary off
-1.000000e+00
```