```
diary on          % begin recording

% FEMA appeal for The Town of Harpswell, Cumberland county, Maine
% TRANSECT ID: CM-139-2
% calculation by SJH, Ransom Consulting, Inc. 20-Feb-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/CM-139-2sta_ele_include.csv';   % file with station, elevation, include
                                       % third colunm is 0 for excluded points
imgname='logfiles/CM-139-2-runup';
SWEL=8.7973;  % 100-yr still water level including wave setup.
H0=7.609;    % significant wave height at toe of structure
Tp=9.0889;   % peak period, 1/fma,
T0=Tp/1.1;

gamma_berm=0.94269;   % this may get changed automatically below
gamma_rough=0.8;
gamma_beta=1;
gamma_perm=1;

setupAtToe=-0.052129;
maxSetup=1.14;   % only used in case of berm/shallow foreshore weighted average

plotTitle='Iterative TAW for CM-139-2'

plotTitle =

Iterative TAW for CM-139-2



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

SWEL=SWEL+setupAtToe

SWEL =

                8.745171

SWEL_fore=SWEL+maxSetup

SWEL_fore =

                9.885171



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

L0 =

        349.332014946232


% 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 =

                -2.668329


% 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 =

                20.158671


% 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 =

         -17.0426691276784

% 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

top_sta =

         145.152873423121


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

top_sta =

         145.152873423121

toe_sta

toe_sta =

         -17.0426691276784



% 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')
```

```matlab
    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 92.9 ft landward of toe of slope

ans =

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

ans =

-!!-   setup is adjusted to 0.35 feet

ans =

-!!-   SWEL is adjusted to 9.14 feet

k =

     1
     2
     3
     4
     5
     6
     7
     8
     9
    10
    11
    12
    13
    14
    15
    16
    17
    18
    19
    20
    21
    22
    23
    24
    25
    26
    27
    28
    29
    30
    31
    32
    33
    34


```matlab
% 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 =
                -2.668329
toe_sta =
       -17.0426691276784
top_sta =
       145.152873423121
Z2 =
                20.158671
H0 =
                    7.609
```

```
Tp =
                    9.0889
T0 =
         8.26263636363636
R2 =
                   22.827
Z2 =
         31.969422882178
top_sta =
         265.11500682733
Lslope =
         282.157675955009
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 38
dh =
         2.64964038217803
rdh_sum =
       0.0729528544092465
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 39
dh =
         2.76118888217803
rdh_sum =
        0.152007036640275
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 40
dh =
         2.87273738217803
rdh_sum =
        0.237385759099084
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 41
dh =
         2.98428638217803
rdh_sum =
         0.3293089103377
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 42
dh =
         3.09583488217803
rdh_sum =
        0.427992849967227
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 43
dh =
         3.20738338217803
rdh_sum =
        0.533650381440317
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 44
dh =
         3.31893188217803
rdh_sum =
        0.646490610365034
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 45
dh =
         3.43048038217803
rdh_sum =
        0.766718833623683
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 46
dh =
         3.54202888217803
rdh_sum =
        0.894536430511264
ans =
Berm Factor Calculation: Iteration 1, Profile Segment: 47
dh =
         3.65357738217803
rdh_sum =
         1.03014075595129
ans =
!------- End Berm Factor Calculation, Iter: 1 ---------!
berm_width =
    10
rB =
       0.0354411765200198
rdh_mean =
        0.103014075595129
gamma_berm =
        0.968209763517194
slope =
        0.127270898241739
Irb =
        0.862351874326477
gamma_berm =
        0.968209763517194
gamma_perm =
    1
```

```
gamma_beta =
     1
gamma_rough =
                    0.8
gamma =
        0.774567810813755
ans =
!!! - - Iribaren number:   0.83 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:7.9 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
        8.99590388994008
R2del =
        13.8310961100599
Z2 =
        18.1383267721181
ans =
!---------------- STARTING ITERATION 2 ----------------!
Ztoe =
                -2.668329
toe_sta =
        -17.0426691276784
top_sta =
        124.632181243201
Z2 =
        18.1383267721181
H0 =
                    7.609
Tp =
                    9.0889
T0 =
        8.26263636363636
R2 =
        8.99590388994008
Z2 =
        18.1383267721181
top_sta =
        124.632181243201
Lslope =
        141.674850370879
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 38
dh =
        2.64964038217803
rdh_sum =
        0.0729528544092465
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 39
dh =
        2.76118888217803
rdh_sum =
        0.152007036640275
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 40
dh =
        2.87273738217803
rdh_sum =
        0.237385759099084
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 41
dh =
        2.98428638217803
rdh_sum =
         0.3293089103377
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 42
dh =
        3.09583488217803
rdh_sum =
        0.427992849967227
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 43
dh =
        3.20738338217803
rdh_sum =
        0.533650381440317
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 44
dh =
        3.31893188217803
rdh_sum =
        0.646490610365034
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 45
dh =
        3.43048038217803
rdh_sum =
        0.766718833623683
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 46
```

```
dh =
          3.54202888217803
rdh_sum =
         0.894536430511264
ans =
Berm Factor Calculation: Iteration 2, Profile Segment: 47
dh =
          3.65357738217803
rdh_sum =
          1.03014075595129
ans =
!------- End Berm Factor Calculation, Iter: 2 ---------!
berm_width =
     10
rB =
         0.0705841578362131
rdh_mean =
         0.103014075595129
gamma_berm =
         0.936687003934945
slope =
         0.158015412309287
Irb =
          1.07066806991935
gamma_berm =
         0.936687003934945
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
         0.749349603147956
ans =
!!! - - Iribaren number:   1.00 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:6.3 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =
          10.8053834479989
R2del =
          1.80947955805879
Z2 =
          19.9478063301769
ans =
!---------------- STARTING ITERATION 3 ----------------!
Ztoe =
                  -2.668329
toe_sta =
         -17.0426691276784
top_sta =
          143.011115141862
Z2 =
          19.9478063301769
H0 =
                      7.609
Tp =
                     9.0889
T0 =
          8.26263636363636
R2 =
          10.8053834479989
Z2 =
          19.9478063301769
top_sta =
          143.011115141862
Lslope =
           160.05378426954
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 38
dh =
          2.64964038217803
rdh_sum =
         0.0729528544092465
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 39
dh =
          2.76118888217803
rdh_sum =
         0.152007036640275
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 40
dh =
          2.87273738217803
rdh_sum =
         0.237385759099084
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 41
dh =
          2.98428638217803
```

```
rdh_sum =
          0.3293089103377
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 42
dh =
          3.09583488217803
rdh_sum =
         0.427992849967227
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 43
dh =
          3.20738338217803
rdh_sum =
         0.533650381440317
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 44
dh =
          3.31893188217803
rdh_sum =
         0.646490610365034
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 45
dh =
          3.43048038217803
rdh_sum =
         0.766718833623683
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 46
dh =
          3.54202888217803
rdh_sum =
         0.894536430511264
ans =
Berm Factor Calculation: Iteration 3, Profile Segment: 47
dh =
          3.65357738217803
rdh_sum =
          1.03014075595129
ans =
!------- End Berm Factor Calculation, Iter: 3 ---------!
berm_width =
    10
rB =
         0.0624789975797098
rdh_mean =
         0.103014075595129
gamma_berm =
         0.943957218600074
slope =
         0.150720193031265
Irb =
          1.02123771227329
gamma_berm =
         0.943957218600074
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                     0.8
gamma =
         0.75516577488006
ans =
!!! - - Iribaren number:   0.96 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 =
          10.3865183675453
R2del =
         0.418865080453521
Z2 =
          19.5289412497234
ans =
!---------------- STARTING ITERATION 4 -----------------!
Ztoe =
                 -2.668329
toe_sta =
         -17.0426691276784
top_sta =
          138.756690939153
Z2 =
          19.5289412497234
H0 =
                   7.609
Tp =
                   9.0889
T0 =
          8.26263636363636
R2 =
          10.3865183675453
```

```
Z2 =
          19.5289412497234
top_sta =
          138.756690939153
Lslope =
          155.799360066831
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 38
dh =
          2.64964038217803
rdh_sum =
       0.0729528544092465
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 39
dh =
          2.76118888217803
rdh_sum =
         0.152007036640275
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 40
dh =
          2.87273738217803
rdh_sum =
         0.237385759099084
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 41
dh =
          2.98428638217803
rdh_sum =
          0.3293089103377
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 42
dh =
          3.09583488217803
rdh_sum =
         0.427992849967227
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 43
dh =
          3.20738338217803
rdh_sum =
         0.533650381440317
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 44
dh =
          3.31893188217803
rdh_sum =
         0.646490610365034
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 45
dh =
          3.43048038217803
rdh_sum =
         0.766718833623683
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 46
dh =
          3.54202888217803
rdh_sum =
         0.894536430511264
ans =
Berm Factor Calculation: Iteration 4, Profile Segment: 47
dh =
          3.65357738217803
rdh_sum =
          1.03014075595129
ans =
!------- End Berm Factor Calculation, Iter: 4 ---------!
berm_width =
    10
rB =
       0.0641851160088875
rdh_mean =
         0.103014075595129
gamma_berm =
         0.942426854383734
slope =
         0.152245320140971
Irb =
          1.03157154537897
gamma_berm =
         0.942426854383734
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                       0.8
gamma =
         0.753941483506987
```

```
ans =
!!! - - Iribaren number:   0.97 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 =
          10.4746095783781
R2del =
        0.0880912108327827
Z2 =
          19.6170324605562
ans =
!---------------- STARTING ITERATION 5 -----------------!
Ztoe =
                  -2.668329
toe_sta =
         -17.0426691276784
top_sta =
          139.651435803077
Z2 =
          19.6170324605562
H0 =
                      7.609
Tp =
                     9.0889
T0 =
          8.26263636363636
R2 =
          10.4746095783781
Z2 =
          19.6170324605562
top_sta =
          139.651435803077
Lslope =
          156.694104930755
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 38
dh =
          2.64964038217803
rdh_sum =
        0.0729528544092465
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 39
dh =
          2.76118888217803
rdh_sum =
         0.152007036640275
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 40
dh =
          2.87273738217803
rdh_sum =
         0.237385759099084
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 41
dh =
          2.98428638217803
rdh_sum =
          0.3293089103377
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 42
dh =
          3.09583488217803
rdh_sum =
         0.427992849967227
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 43
dh =
          3.20738338217803
rdh_sum =
         0.533650381440317
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 44
dh =
          3.31893188217803
rdh_sum =
         0.646490610365034
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 45
dh =
          3.43048038217803
rdh_sum =
         0.766718833623683
ans =
Berm Factor Calculation: Iteration 5, Profile Segment: 46
dh =
          3.54202888217803
rdh_sum =
         0.894536430511264
ans =
Berm Factor Calculation V: Iteration 5, Profile Segment: 47
```

```
dh =
          3.65357738217803
rdh_sum =
          1.03014075595129
ans =
!------- End Berm Factor Calculation, Iter: 5 ---------!
berm_width =
    10
rB =
          0.0638186101794902
rdh_mean =
          0.103014075595129
gamma_berm =
          0.942755604953916
slope =
          0.15191722578815
Irb =
          1.02934847015896
gamma_berm =
          0.942755604953916
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
                      0.8
gamma =
          0.754204483963133
ans =
!!! - - Iribaren number:   0.97 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 =
          10.455682429523
R2del =
          0.0189271488550808
Z2 =
          19.5981053117011
ans =
!---------------- STARTING ITERATION 6 -----------------!
Ztoe =
                -2.668329
toe_sta =
          -17.0426691276784
top_sta =
          139.459192228869
Z2 =
          19.5981053117011
H0 =
                     7.609
Tp =
                    9.0889
T0 =
          8.26263636363636
R2 =
           10.455682429523
Z2 =
          19.5981053117011
top_sta =
          139.459192228869
Lslope =
          156.501861356547
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 38
dh =
          2.64964038217803
rdh_sum =
          0.0729528544092465
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 39
dh =
          2.76118888217803
rdh_sum =
          0.152007036640275
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 40
dh =
          2.87273738217803
rdh_sum =
          0.237385759099084
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 41
dh =
          2.98428638217803
rdh_sum =
           0.3293089103377
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 42
dh =
          3.09583488217803
```

```
rdh_sum =
        0.427992849967227
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 43
dh =
        3.20738338217803
rdh_sum =
        0.533650381440317
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 44
dh =
        3.31893188217803
rdh_sum =
        0.646490610365034
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 45
dh =
        3.43048038217803
rdh_sum =
        0.766718833623683
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 46
dh =
        3.54202888217803
rdh_sum =
        0.894536430511264
ans =
Berm Factor Calculation: Iteration 6, Profile Segment: 47
dh =
        3.65357738217803
rdh_sum =
        1.03014075595129
ans =
!------- End Berm Factor Calculation, Iter: 6 ---------!
berm_width =
    10
rB =
        0.0638970036095462
rdh_mean =
        0.103014075595129
gamma_berm =
        0.94268528715059
slope =
        0.151987381631353
Irb =
        1.02982382645577
gamma_berm =
        0.94268528715059
gamma_perm =
     1
gamma_beta =
     1
gamma_rough =
                        0.8
gamma =
        0.754148229720472
ans =
!!! - - Iribaren number:   0.97 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 =
        10.4597306723276
R2del =
      0.00404824280455962
Z2 =
        19.6021535545056
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =
        19.6021535545056
diary off
-1.000000e+00
```