

```

diary on          % begin recording

% FEMA appeal for The Town of Kittery, York county, Maine
% TRANSECT ID: YK-06F
% calculation by SJH, Ransom Consulting, Inc. 19-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='infiles/YK-06Fsta_ele_include.csv'; % file with station, elevation, include
                                     % third column 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=0.9548; % this may get changed automatically below
gamma_rough=0.6;
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 consistent with TAW guidance should be performed
% prior to the input of the significant wave height given above.
Ztoe=SWEL-1.5*H0

Ztoe =

```

0.81954

```
% 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',d
    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=0.01; % 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)) ;
            end
        end
    end
end
```

```

        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('!!! - - Iribarren number: %6.2f is outside the valid range (0.5-10), TAW NOT VALID - - !!!\n', Irb)
    TAW_VALID=0;
else
    sprintf('!!! - - Iribarren number: %6.2f is in the valid range (0.5-10), TAW RECOMMENDED - - !!!\n', Irb)
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
        R2_new=w2*fore_R2 + w1*R2_new
    end
end

```

```

        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 =
    0.6
gamma =
    0.584774543174243
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 =
    7.30799817581677
R2del =
    9.15660182418323
Z2 =
    16.3598381758168
ans =
!----- STARTING ITERATION 2 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    97.7887339040572
Z2 =
    16.3598381758168
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    7.30799817581677
Z2 =
    16.3598381758168
top_sta =
    97.7887339040572
Lslope =
    75.0625487024622
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 =
    0.0666111141498715
rdh_mean =
    0.143881016745364
gamma_berm =
    0.942972960680553
slope =
    0.221806064204322
Irb =
    1.89127846552481
gamma_berm =
    0.942972960680553
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.6
gamma =
    0.565783776408332
ans =
!!! - - Iribaren number: 1.78 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:4.5 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!

```

```

R2_new =      10.3946330745517
R2del =      3.08663489873491
Z2 =      19.4464730745517
ans =
!----- STARTING ITERATION 3 -----!
Ztoe =      0.81954
toe_sta =      22.726185201595
top_sta =      129.349417940202
Z2 =      19.4464730745517
H0 =      5.4882
Tp =      9.7138
T0 =      8.83072727272727
R2 =      10.3946330745517
Z2 =      19.4464730745517
top_sta =      129.349417940202
Lslope =      106.623232738607
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 =      0.0468940949507487
rdh_mean =      0.143881016745364
gamma_berm =      0.959853075110119
slope =      0.183294041850288
Irb =      1.56289718883032
gamma_berm =      0.959853075110119
gamma_perm =
1
gamma_beta =
1
gamma_rough =      0.6
gamma =      0.575911845066071
ans =
!!! - - Iribaren number: 1.50 is in the valid range (0.5-10), TAW RECOMMENDED - - !!!
ans =
!!! - - slope: 1:5.5 V:H is in the valid range (1:8 - 1:1), TAW RECOMMENDED - - !!!
R2_new =      8.74358662000387
R2del =      1.65104645454781
Z2 =      17.7954266200039
ans =
!----- STARTING ITERATION 4 -----!

```

```

Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    112.467552351778
Z2 =
    17.7954266200039
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    8.74358662000387
Z2 =
    17.7954266200039
top_sta =
    112.467552351778
Lslope =
    89.7413671501831
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 =
    0.0557156655707334
rdh_mean =
    0.143881016745364
gamma_berm =
    0.952300761040228
slope =
    0.200325852542812
Irb =
    1.70812268979766
gamma_berm =
    0.952300761040228
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.6
gamma =
    0.571380456624137
ans =
!!! - - Iribaren number: 1.63 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 =
    9.48085794146406
R2del =
    0.737271321460193
Z2 =
    18.5326979414641
ans =
!----- STARTING ITERATION 5 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    120.006113920901
Z2 =
    18.5326979414641

```



```

H0 =
                    5.4882
Tp =
                    9.7138
T0 =
    8.83072727272727
R2 =
    9.48085794146406
Z2 =
    18.5326979414641
top_sta =
    120.006113920901
Lslope =
    97.2799287193058
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 =
    0.0513980639770732
rdh_mean =
    0.143881016745364
gamma_berm =
    0.955997141726691
slope =
    0.191950277674611
Irb =
    1.63670649817349
gamma_berm =
    0.955997141726691
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.6
gamma =
    0.573598285036015
ans =
!!! - - Iribaren number: 1.56 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 =
    9.1197271855973
R2del =
    0.361130755866759
Z2 =
    18.1715671855973
ans =
!----- STARTING ITERATION 6 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    116.313570404881
Z2 =
    18.1715671855973
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    9.1197271855973

```

```

Z2 =
    18.1715671855973
top_sta =
    116.313570404881
Lslope =
    93.5873852032857
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 =
    0.053426003826683
rdh_mean =
    0.143881016745364
gamma_berm =
    0.954260983924542
slope =
    0.195874696445535
Irb =
    1.6701689228271
gamma_berm =
    0.954260983924542
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.6
gamma =
    0.572556590354725
ans =
!!! - - Iribaren number: 1.59 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 =
    9.28927911205426
R2del =
    0.169551926456956
Z2 =
    18.3411191120543
ans =
!----- STARTING ITERATION 7 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    118.047230184604
Z2 =
    18.3411191120543
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    9.28927911205426
Z2 =
    18.3411191120543
top_sta =
    118.047230184604
Lslope =
    95.3210449830092
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 =
0.0524543137445801
rdh_mean =
0.143881016745364
gamma_berm =
0.95509286624967
slope =
0.193992209848218
Irb =
1.6541174844865
gamma_berm =
0.95509286624967
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.573055719749802
ans =
!!! - - Iribaren number: 1.58 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 =
9.20802309211259
R2del =
0.081256019941673
Z2 =
18.2598630921126
ans =
!----- STARTING ITERATION 8 -----!
Ztoe =
0.81954
toe_sta =
22.726185201595
top_sta =
117.216391534894
Z2 =
18.2598630921126
H0 =
5.4882
Tp =
9.7138
T0 =
8.83072727272727
R2 =
9.20802309211259
Z2 =
18.2598630921126
top_sta =
117.216391534894
Lslope =
94.4902063332988
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 =
    0.0529155369008648
rdh_mean =
    0.143881016745364
gamma_berm =
    0.954698004350058
slope =
    0.194885270765357
Irb =
    1.66173236592379
gamma_berm =
    0.954698004350058
gamma_perm =
    1
gamma_beta =
    1
gamma_rough =
    0.6
gamma =
    0.572818802610035
ans =
!!! - - Iribaren number: 1.59 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 =
    9.24658869280951
R2del =
    0.0385656006969288
Z2 =
    18.2984286928095
ans =
!----- STARTING ITERATION 9 -----!
Ztoe =
    0.81954
toe_sta =
    22.726185201595
top_sta =
    117.610722830364
Z2 =
    18.2984286928095
H0 =
    5.4882
Tp =
    9.7138
T0 =
    8.83072727272727
R2 =
    9.24658869280951
Z2 =
    18.2984286928095
top_sta =
    117.610722830364
Lslope =
    94.8845376287685
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 =
          0.0526956248610525
rdh_mean =
          0.143881016745364
gamma_berm =
          0.954886275221988
slope =
          0.194459349226437
Irb =
          1.65810065171682
gamma_berm =
          0.954886275221988
gamma_perm =
          1
gamma_beta =
          1
gamma_rough =
          0.6
gamma =
          0.572931765133193
ans =
!!! - - Iribaren number: 1.58 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 =
          9.22819976863614
R2del =
          0.0183889241733777
Z2 =
          18.2800397686361
ans =
!----- STARTING ITERATION 10 -----!
Ztoe =
          0.81954
toe_sta =
          22.726185201595
top_sta =
          117.42269702082
Z2 =
          18.2800397686361
H0 =
          5.4882
Tp =
          9.7138
T0 =
          8.83072727272727
R2 =
          9.22819976863614
Z2 =
          18.2800397686361
top_sta =
          117.42269702082
Lslope =
          94.6965118192247
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 =
0.0528002552992129
rdh_mean =
0.143881016745364
gamma_berm =
0.954796699117653
slope =
0.194661970844822
Irb =
1.65982834976185
gamma_berm =
0.954796699117653
gamma_perm =
1
gamma_beta =
1
gamma_rough =
0.6
gamma =
0.572878019470592
ans =
!!! - - Iribaren number: 1.58 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 =
9.23694873213893
R2del =
0.00874896350279109
Z2 =
18.2887887321389
% final 2% runup elevation
Z2=R2_new+SWEL
Z2 =
18.2887887321389
diary off
-1.000000e+00

```