APPENDIX S1

Matlab Program for Soil Classification

SOIL CLASSIFICATION CODE

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function [] = matlabbbbb
while(1)
disp('================================================')
disp('A MATLAB PROGRAM FOR SOIL CLASSIFICATION')
disp('================================================')
% |---------------------------------------|
disp('================================================')
disp(' Classification of Soils Using Differents Standards')
disp(' select an option:')
disp(' 1 - American Association of State Highway Transportation Officials (AASHTO)')
disp(' 2 - Use of Plasticity Chart in accordance to AASHTO')
disp(' 3 - Unified System of Classification of Soils (USCS)')
disp(' 4 - Indian System of soil Classification (ISC)')
disp(' 5 - ASTM-CS 2004')
disp('================================================')
itype = input('');
if  itype == 1
   disp('You Are Classifying using AASHTO')
S1 = input('enter the percentage passing Sieve number 10: \n');
S2 = input('enter the percentage passing Sieve Number 40: \n');
S3 = input('enter the percentage passing Sieve Number 200: \n');
LL = input('enter the Liquid Limit: \n');
PI = input('enter the plasticity index: \n');
GI = ((S3-35)*(0.2+0.005*(LL-40))) + (0.01*(S3-15)*(PI-10));
if GI < 0
 GroupIndex = '0'
else
Groupindex = round(GI)
end
if S1 <=50 & S2 <=30 & S3 <=15
   class = strcat('the soil is A-1-a')
   disp('Major Constituent Material =Stone fragment Gravel and Sand')
   disp('General Rating as a Subgrade Material = Excellent')
elseif S2 <=50 & S3 <= 25
   class = strcat('the soil is A-1-b')
   disp('Major Constituent Material =Stone fragment Gravel and Sand')
   disp('General Rating as a Subgrade Material = Excellent')
elseif S2 >= 51 & S3 <= 10
   class = strcat('the soil is A-3')
   disp('Major Constituent Material = Fine Sand')
   disp('General Rating as a Subgrade Material = Excellent')
elseif S3 <=35 & LL <= 40 & PI <= 10
   class = strcat('the soil is A-2-4')
   disp('Major Constituent Material = Silty or Clayey Gravel Sand')
   disp('General Rating as a Subgrade Material = Good')
elseif S3 <=35 & LL >= 41 & PI <= 10
   class = strcat('the soil is A-2-5')
   disp('Major Constituent Material = Silty or Clayey Gravel Sand')
   disp('General Rating as a Subgrade Material = Good')
elseif S3 <=35 & LL <= 40 & PI >= 11
   class = strcat('the soil is A-2-6')
   disp('Major Constituent Material = Silty or Clayey Gravel Sand')
   disp('General Rating as a Subgrade Material = Good')
elseif S3 <=35 & LL >= 41 & PI >= 10
   class = strcat('the soil is A-2-7')
   disp('Major Constituent Material = Silty or Clayey Gravel Sand')
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   disp('General Rating as a Subgrade Material = Good')
elseif S3 >=36 & LL <= 40 & PI <= 10
   class = strcat('the soil is A-4')
   disp('Major Constituent Material = Silty Soil')
   disp('General Rating as a Subgrade Material = Fair')
elseif S3 >=36 & LL >= 41 & PI <= 10
    class = strcat('the soil is A-5')
   disp('Major Constituent Material = Silty Soil')
   disp('General Rating as a Subgrade Material = Fair')
elseif S3 >=36 & LL >= 41 & PI <= 10
   class = strcat('the soil is A-6')
   disp('Major Constituent Material = Clayey Soil')
   disp('General Rating as a Subgrade Material = Poor')
elseif S3 >=36 & LL >= 41 & PI > 30
   class = strcat('the soil is A-7-5')
   disp('Major Constituent Material = Clayey Soil')
   disp('General Rating as a Subgrade Material = Poor')
elseif S3 >=36 & LL >= 41 & PI < 30
  class = strcat('the soil is A-7-6')
   disp('Major Constituent Material = Clayey Soil')
   disp('General Rating as a Subgrade Material = Poor')
else
end
m=input('Do you want to continue, Y/N [Y]:','s')
if m=='N'
break
end
elseif itype == 2
   disp('You are Using AASHTO Plasticity Chart')
   disp('NOTE: some of the soils will be given two classes due to limited parameters')
LL = input('enter the Liquid Limit: \n');
PI = input('enter the plasticity index: \n');
A = LL - 30;
if PI >= 0 & PI <= 10 & LL >= 0 & LL <= 40
   class = strcat('The soil is either A-4 or A-2-4')
   disp('if the plasticity index of the soil is within the region above 5, the more likelihood for the soil to be an A-4 soil')
elseif  PI >= 10 & PI <= 70 & LL >= 0 & LL <= 40
   class = strcat('The soil is either A-6 or A-2-6')
   disp('the higher the plasticity index, the more likelihood for the soil to be an A-6 soil')
elseif PI > A & PI > 10 & LL >= 40 & LL <= 100
   class = strcat('The soil is A-7-6')
elseif PI < A & PI > 10 & LL >= 40 & LL <= 100
   class = strcat('The soil is either A-7-5 or A-2-7')
   disp('the higher the plasticity index, the more likelihood for the soil to be an A-7-5 soil')
elseif PI >= 0 & PI <= 10 & LL >= 40 & LL <= 100
 class = strcat('The soil is either A-5 or A-2-5')
   disp('if the plasticity index of the soil is within the region above 5, the more likelihood for the soil to be an A-5 soil')
else
end
m=input('Do you want to continue, Y/N [Y]:','s')
if m=='N'
break
end
elseif itype == 3
   disp('You are using Unified Soil Classification System')
F =input('enter the percentage retained in Sieve NO 4 (4.75mm): \n');
Cu = input('enter the coefficient of Uniformity Cu: \n');
Cc = input('enter the coefficient of Curvature Cc: \n');
F2 = input('enter the percentage passing in Sieve NO 4 (4.75mm): \n');
S1 = input('enter the percentage passing sieve No 200 (0.075mm): \n');
LL = input('enter the Liquid Limit: \n');
PI = input('enter the plasticity index: \n');
ALine = 0.73*(LL-20);
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if F >= 50 & S1 < 5 & Cu >4 & Cc >=1 & Cc <= 3
class = strcat('the soil Group Symbol is GW')
   disp('Typical Name = Well Graded Gravels')
elseif F >= 50 & S1 < 5 & Cu <= 4 & Cc > 3
   class = strcat('the soil Group Symbol is GP')
  disp('Typical Name = poorly Graded Gravels')
elseif F >= 50 & S1 < 5 & Cu <= 4 & Cc < 1
      class = strcat('the soil Group Symbol is GP')
  disp('Typical Name = poorly Graded Gravels')
elseif F >= 50 & PI < ALine & S1 > 12 & S1 < 50
   class = strcat('the soil Group Symbol is GM')
   disp('Typical Name = Silty Gravel (i.e garavels with sand)')
elseif F >= 50 & PI < 4 & S1 > 12 & S1 < 50
   class = strcat('the soil Group Symbol is GM')
   disp('Typical Name = Silty Gravel (i.e garavels with fine sand)')
elseif F >= 50 & PI > ALine & PI > 7 & S1 > 12 & S1 < 50
   class = strcat('the soil Group Symbol is GC')
   disp('Typical Name = Clayey Gravels (i.e garavels with fine sand)')
elseif F >= 50 & ALine >=4 & ALine <= 7 & PI > ALine & S1 > 12
   class = strcat('the soil Group Symbol is GM-GC')
   disp('Typical Name = Silty and Clayey Gravels (i.e garavels with fine sand)')
elseif F >= 50  & S1 >=5 & S1 <= 12
   class = strcat('the soil Group Symbol is GW-GM')
   disp('Typical Name = well graded and silty gravels')
elseif F2 >= 50 & S1 < 5 & Cu >6 & Cc >=1 & Cc <= 3
   class = strcat('the soil Group Symbol is SW')
   disp('Typical Name = Well graded Sand(Clean Sands) ')
elseif F2 >= 50 & S1 < 5 & Cu <6 & Cc > 3
   class = strcat('the soil Group Symbol is SP')
    disp('Typical Name = Poorly graded Sand(Clean Sands)')
elseif F2 >= 50 & S1 < 5 & Cu <6 & Cc < 1
       class = strcat('the soil Group Symbol is SP')
    disp('Typical Name = Poorly graded Sand (Clean Sands)')
elseif F2 >= 50 & PI < ALine & S1 > 12 & S1 < 50
   class = strcat('the soil Group Symbol is SM')
   disp('Typical Name = Silty Sands (Sands with Fines)')
elseif F2 >= 50 & PI < 4 & S1 > 12 & S1 < 50
       class = strcat('the soil Group Symbol is SM')
   disp('Typical Name = Silty Sands (Sands with Fines)')
elseif F2 >= 50 & PI > ALine & PI > 7 & S1 > 12 & S1 < 50
   class = strcat('the soil Group Symbol is SC')
   disp('Typical Name = Clayey Sands (Sands with Fines)')
elseif F2 >= 50 & ALine >=4 & ALine <= 7 & PI > ALine & S1 > 12
   class = strcat('the soil Group Symbol is SM-SC')
   disp('Typical Name = Silty and Clayey Sands (i.e Sands with Fines)')
elseif F2 >= 50 & S1 >= 5 & S1 <= 12
    class = strcat('the soil Group Symbol is SP-SC')
   disp('Typical Name = Poor graded and Clayey Sands')
elseif S1 >= 50 & LL <= 50 & PI < ALine
   class = strcat('the soil Group Symbol is either ML or OL')
   disp('Typical Name = Inorganic or Organic Silt of Low Plasticity')
   disp('the ML and OL plots in the same zone in the plasticity chart the distinction between them is made by oven
         drying,')
   disp('if oven drying decreases the Liquid Limit by 30% or more its OL else ML')
elseif S1 >= 50 & LL <= 50 & PI > ALine
   class = strcat('the soil Group Symbol is either CL')
    disp('Typical Name = Inorganic Clays of Medium Plasticity')
elseif S1 >= 50 & LL <= 50 & ALine >= 4 & ALine <= 7 & PI > ALine
   class = strcat('the soil Group Symbol is either CL-ML')
   disp('Typical Name = Inorganic Clays of Low Plasticity and Inorganic Silt of Low Plasticity')
elseif S1 >= 50 & LL > 50 &  PI < ALine
    class = strcat('the soil Group Symbol is either MH or OH')
    disp('Typical Name = Inorganic silt of High Plasticity or Organic Clay of Medium-High Plasticity')
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    disp('the MH and OH plots in the same zone in the plasticity chart the distinction between')
    disp('is made by oven drying if oven drying decreases the Liquid Limit by 30% or more its OH else MH')
elseif S1 >= 50 & LL > 50 & PI > ALine
   class = strcat('the soil Group Symbol is either CH')
    disp('Typical Name = Inorganic Clays of High Plasttcity')
else
  disp('INPUT VARIABLES MIGHT BE OUT OF RANGE')
end
m=input('Do you want to continue, Y/N [Y]:','s')
if m=='N'
break
end
elseif itype == 4
   disp('You are Using the Indian System of Soil Classification')
 E = input('please enter the percentage retained in sieve 4.75mm IS Sieve: \n');
cu = input('Please enter the coefficient of Uniformity Cu: \n');
cc = input('Please enter the coefficient of Curvature Cc: \n');
E2 = input('please enter the percentage passing in sieve 4.75mm IS Sieve: \n');
S = input('please enter the percentage passing 75microns IS Sieve (0.075mm): \n');
ll = input('enter the Liquid Limit: \n');
pi = input('enter the plasticity index: \n');
ALine = 0.73*(ll-20);
if S < 50 & E >= 50 & cu >4 & cc >= 1 & cc <= 3 & S < 5
  class = strcat('the soil Group Symbol According to ISC Standard is GW')
  disp('Typical Name = Well Graded Gravels (i.e Clean gravels)')
elseif S < 50 & E >= 50 & S < 5 & cu <= 4 & cc > 3
  class = strcat('the soil Group Symbol According to ISC Standard is GP')
  disp('Typical Name = poorly Graded Gravels (i.e Clean gravels)')
elseif S < 50 & E >= 50 & S < 5 & cu <= 4 & cc < 1
  class = strcat('the soil Group Symbol According to ISC Standard is GP')
  disp('Typical Name = poorly Graded Gravels(i.e Clean gravels)')
elseif S < 50 & E >= 50 & pi < ALine & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is GM')
   disp('Typical Name = Silty Gravel (i.e garavels with appreciable amount of Fines)')
elseif S < 50 & E >= 50 & pi < 4 & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is GM')
   disp('Typical Name = Silty Gravel (i.e garavels with appreciable amount of Fines)')
elseif S < 50 & E >= 50 & pi > ALine & pi > 7 & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is GC')
   disp('Typical Name = Clayey Gravels (i.e garavels with appreciable amount of Fines)')
elseif S < 50 & E >= 50 & pi >=4 & pi <= 7 & pi > ALine & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is GM-GC')
   disp('Typical Name = Silty and Clayey Gravels (i.e garavels with appreciable amount of Fines)')
elseif S < 50 & E >= 50 & S >= 5 & S <= 12
   class = strcat('the soil Group Symbol According to ISC Standard is GP-GM')
   disp('Typical Name = poor graded and silty gravels')
elseif S < 50 & E2 > 50 & S < 5 & cu >6 & cc >=1 & cc <= 3
   class = strcat('the soil Group Symbol According to ISC Standard is SW')
   disp('Typical Name = Well graded Sands(Clean Sands)')
elseif S < 50 & E2 > 50 & S < 5 & cu < 6 & cc > 3
   class = strcat('the soil Group Symbol According to ISC Standard is SP')
   disp('Typical Name = Poorly graded Sands(Clean Sands)')
elseif S < 50 & E2 > 50 & S < 5 & cu <6 & cc < 1
       class = strcat('the soil Group Symbol According to ISC Standard is SP')
   disp('Typical Name = Poorly graded Sand (Clean Sands)')
elseif S < 50 & E2 > 50 & pi < ALine & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is SM')
   disp('Typical Name = Silty Sands (Sands with Fines)')
elseif S < 50 & E2 > 50 & pi < 4 & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is SM')
   disp('Typical Name = Silty Sands (Sands with Fines)')
elseif S < 50 & E2 > 50 & pi > ALine & pi > 7 & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is SC')
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   disp('Typical Name = Clayey Sands (Sands with Fines)')
elseif S < 50 & E2 > 50 & pi >=4 & pi <= 7 & pi > ALine & S > 12
   class = strcat('the soil Group Symbol According to ISC Standard is SM-SC')
   disp('Typical Name = Silty and Clayey Sands (i.e Sands with Fines)')
elseif S < 50 & E2 > 50 & S >= 5 & S <= 12
   class = strcat('the soil Group Symbol According to ISC Standard is SW-SM')
   disp('Typical Name = Well graded and Clayey Sands')
elseif S >= 50 & ll <= 35 & pi < ALine
   class = strcat('the soil Group Symbol According to ISC Standard is ML or OL')
   disp('Typical Name = Inorganic Silt with none to low plasticity or Organic Silt of Low ')
   disp(' REMARK = Organic and inorganic soils plotted in the same zone in plasticity chart')
   disp('are distinguished by odour and colour or liquid limit test after oven-drying.')
   disp('A reduction in liquid limit after oven-drying to a value less than three-fourth of liquid limit')
   disp ('before oven drying is positive indentification of organic soils')
elseif S >= 50 & ll <= 35 & pi < 7
   class = strcat('the soil Group Symbol According to ISC Standard is ML or OL')
   disp('Typical Name = Inorganic Silt with none to low plasticity or Organic Silt of Low')
   disp(' REMARK = Organic and inorganic soils plotted in the same zone in plasticity chart')
   disp('are distinguished by odour and colour or liquid limit test after oven-drying.')
   disp('A reduction in liquid limit after oven-drying to a value less than three-fourth of liquid')
   disp('limit before oven drying is positive indentification of organic soils')
elseif S >= 50 & ll <= 35 & pi > ALine & pi > 7
   class = strcat('the soil Group Symbol According to ISC Standard is CL')
   disp('Typical Name = Inorganic Clays of low plasticity')
elseif S >=50 & ll <= 35 & pi > ALine & pi >= 4 & pi <= 7
   class = strcat('the soil Group Symbol According to ISC Standard is ML-CL (Batched Zone)')
   disp('Typical Name = Inorganic Silt with none to low plasticity and Inorganic Clays of low plasticity')
elseif S >= 50 & ll >= 35 & ll <= 50 pi < ALine
   class = strcat('the soil Group Symbol According to ISC Standard is MI or OI')
   disp('Typical Name = Inorganic Silt of Medium Plasticity or Organic Silt of Medium Plasticity')
   disp(' REMARK = Organic and inorganic soils plotted in the same zone in plasticity chart')
   disp('are distinguished by odour and colour or liquid limit test after oven-drying.')
   disp('A reduction in liquid limit after oven-drying to a value less than three-fourth of liquid')
   disp('limit before oven drying is positive indentification of organic soils')
elseif S >= 50 & ll >= 35 & ll <= 50 & pi > ALine
   class = strcat('the soil Group Symbol According to ISC Standard is CI')
   disp('Typical Name = Inorganic Clays of Medium plasticity')
elseif S >= 50 & ll > 50 &  pi < ALine
   class = strcat('the soil Group Symbol According to ISC Standard is MH or OH')
   disp('Typical Name = Inorganic Silt of High Compressibility or Organic Clays of Medium to high Plasticity')
   disp(' REMARK = Organic and inorganic soils plotted in the same zone in plasticity chart')
   disp('are distinguished by odour and colour or liquid limit test after oven-drying.')
   disp('A reduction in liquid limit after oven-drying to a value less than three-fourth of liquid limit before')
   disp('oven drying is positive indentification of organic soils')
elseif S >= 50 &  ll > 50 & pi > ALine
   class = strcat('the soil Group Symbol According to ISC Standard is CH')
   disp('Typical Name = Inorganic Clays of High Plasticity')
else
end
m=input('Do you want to continue, Y/N [Y]:','s')
if m=='N'
break
end
elseif itype == 5
  disp('You are Using ASTM-2004')
   F1 =input('enter the percentage retained in Sieve NO 4 (4.75mm) i.e. Gravel Fraction: \n');
S1 = input('enter the percentage retained sieve No 200 (0.075mm)i.e. Coarse Fraction: \n');
S2 = input('enter the percentage passing sieve No 200 (0.075mm) i.e. Fine Fraction (clay + silt): \n');
silt = input('enter the percentage of Silt: \n');
clay = input('enter the percentage of Clay: \n');
Cu = input('enter the coefficient of Uniformity Cu: \n');
Cc = input('enter the coefficient of Curvature Cc: \n');
LL = input('enter the Liquid Limit: \n');
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PI = input('enter the plasticity index: \n');
LLR = input('enter the Liquid Limit Ratio: \n');
ALine = 0.73*(LL-20);
sandfraction = S1-F1;
if S1 > 50 & F1 > sandfraction & S2 > 12 & clay < silt & sandfraction < 15
   class = strcat('the soil Group Symbol is GM')
   disp('Group Name = Silty Gravels')
elseif S1 > 50 & F1 > sandfraction & S2 > 12 & clay < silt & sandfraction >= 15
   class = strcat('the soil Group Symbol is GM')
   disp('Group Name = Silty Gravels with Sand')
elseif S1 > 50 & F1 > sandfraction & S2 > 12 & clay > silt & sandfraction < 15
   class = strcat('the soil Group Symbol is GC')
   disp('Group Name = Clayey Gravel')
elseif S1 > 50 & F1 > sandfraction & S2 > 12 & clay > silt & sandfraction >= 15
   class = strcat('the soil Group Symbol is GC')
   disp('Group Name = Clayey Gravel with sand')
elseif  S1 > 50 & F1 > sandfraction & S2 < 5 & Cu >= 4 & Cc >=1 & Cc <= 3 & sandfraction < 15
   class = strcat('the soil Group Symbol is GW')
   disp('Group Name =Well Graded Gravel')
elseif  S1 > 50 & F1 > sandfraction & S2 < 5 & Cu >= 4 & Cc >=1 & Cc <= 3 & sandfraction >= 15
   class = strcat('the soil Group Symbol is GW')
   disp('Group Name =Well Graded Gravel with Sand')
elseif  S1 > 50 & F1 > sandfraction & S2 < 5 & Cu < 4 & Cc < 1 & sandfraction < 15
   class = strcat('the soil Group Symbol is GP')
   disp('Group Name =Poorly Graded Gravel')
elseif  S1 > 50 & F1 > sandfraction & S2 < 5 & Cu < 4 & Cc < 1 & sandfraction >= 15
   class = strcat('the soil Group Symbol is GP')
   disp('Group Name =Poorly Graded Gravel with Sand')
elseif  S1 > 50 & F1 > sandfraction & S2 < 5 & Cu < 4 & Cc > 3 & sandfraction < 15
   class = strcat('the soil Group Symbol is GP')
   disp('Group Name =Poorly Graded Gravel')
elseif  S1 > 50 & F1 > sandfraction & S2 < 5 & Cu < 4 & Cc > 3 & sandfraction >= 15
   class = strcat('the soil Group Symbol is GP')
   disp('Group Name =Poorly Graded Gravel with Sand')
elseif S1 > 50 & F1 < sandfraction & S2 > 12 & clay < silt & F1 < 15
   class = strcat('the soil Group Symbol is SM')
   disp('Group Name = Silty Sands')
elseif S1 > 50 & F1 < sandfraction & S2 > 12 & clay < silt & F1 >= 15
   class = strcat('the soil Group Symbol is SM')
   disp('Group Name = Silty Sands with Gravel')
elseif S1 > 50 & F1 < sandfraction & S2 > 12 & clay > silt & F1 < 15
   class = strcat('the soil Group Symbol is SC')
   disp('Group Name = Clayey Sand  with Gravel')
elseif S1 > 50 & F1 < sandfraction & S2 > 12 & clay > silt & F1 >= 15
   class = strcat('the soil Group Symbol is SC')
   disp('Group Name = Clayey sand with gravel')
elseif S1 > 50 & F1 < sandfraction & S2 < 5 & Cu >= 6 & Cc >= 1 & Cc <= 3 & F1 < 15
   class = strcat('the soil Group Symbol is SW')
   disp('Group Name =Well Graded Sand')
elseif S1 > 50 & F1 < sandfraction & S2 < 5 & Cu >= 6 & Cc >= 1 & Cc <= 3 & F1 >= 15
   class = strcat('the soil Group Symbol is SW')
   disp('Group Name =Well Graded Sand with Gravel')
elseif S1 > 50 & F1 < sandfraction & S2 < 5 & Cu < 6 & Cc < 1 & F1 < 15
   class = strcat('the soil Group Symbol is SP')
   disp('Group Name =Poorly Graded Sand')
elseif S1 > 50 & F1 < sandfraction & S2 < 5 & Cu < 6 & Cc < 1 & F1 >= 15
   class = strcat('the soil Group Symbol is SP')
   disp('Group Name =Poorly Graded Sand with Gravel')
elseif S1 > 50 & F1 < sandfraction & S2 < 5 & Cu < 6 & Cc > 3 & F1 < 15
   class = strcat('the soil Group Symbol is SP')
   disp('Group Name =Poorly Graded Sand')
elseif S1 > 50 & F1 < sandfraction & S2 < 5 & Cu < 6 & Cc > 3 & F1 >= 15
   class = strcat('the soil Group Symbol is SP')
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   disp('Group Name =Poorly Graded Sand with Gravel')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu >= 4 & Cc >= 1 & Cc <= 3 & sandfraction
        < 15
    class = strcat('the soil Group Symbol is GW-GC')
   disp('Group Name = Well Graded Gravel with Clay (Silty Clay)')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu >= 4 & Cc >= 1 & Cc <= 3 & sandfraction
        >= 15
    class = strcat('the soil Group Symbol is GW-GC')
   disp('Group Name = Well Graded Gravel with Clay  and sand (Silty Clay and sand)')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 4 & Cc < 1  & sandfraction < 15
   class = strcat('the soil Group Symbol is GP-GC')
   disp('Group Name = Poorly Graded Gravel with Clay (Silty Clay)')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 4 & Cc < 1 & sandfraction >= 15
   class = strcat('the soil Group Symbol is GP-GC')
   disp('Group Name = Poorly Graded Gravel with Clay  and sand (Silty Clay and sand)')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 4 & Cc > 3 &  sandfraction < 15
   class = strcat('the soil Group Symbol is GP-GC')
   disp('Group Name = Poorly Graded Gravel with Clay (Silty Clay)')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 4 & Cc > 3 & sandfraction >= 15
   class = strcat('the soil Group Symbol is GP-GC')
   disp('Group Name = Poorly Graded Gravel with Clay  and sand (Silty Clay and sand)')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu >= 4 & Cc >= 1 & Cc <= 3 & sandfraction
        < 15
    class = strcat('the soil Group Symbol is GW-GM')
   disp('Group Name = Well Graded Gravel with Silt')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu >= 4 & Cc >= 1 & Cc <= 3 & sandfraction
        >= 15
    class = strcat('the soil Group Symbol is GW-GM')
   disp('Group Name = Well Graded Gravel with Silt and sand')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 4 & Cc < 1 & sandfraction < 15
   class = strcat('the soil Group Symbol is GP-GM')
   disp('Group Name = Poorly Graded Gravel with Silt')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 4 & Cc < 1 & sandfraction >= 15
   class = strcat('the soil Group Symbol is GP-GM')
   disp('Group Name = Poorly Graded Gravel with Silt and Sand)')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 4 & Cc > 3 & sandfraction < 15
   class = strcat('the soil Group Symbol is GP-GM')
   disp('Group Name = Poorly Graded Gravel with Silt')
elseif S1 > 50 & F1 > sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 4 & Cc > 3 & sandfraction >= 15
   class = strcat('the soil Group Symbol is GP-GM')
   disp('Group Name = Poorly Graded Gravel with Silt and Sand)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu >= 6 & Cc >= 1 & Cc <= 3  & F1 < 15
    class = strcat('the soil Group Symbol is SW-SC')
   disp('Group Name = Well Graded Sand with Clay (Silty Clay)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu >= 6 & Cc >= 1 & Cc <= 3 & F1 >= 15
    class = strcat('the soil Group Symbol is SW-SC')
   disp('Group Name = Well Graded Sand with Clay and Gravel (or Silty Clay and Gravel)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 6 & Cc < 1 & F1 < 15
   class = strcat('the soil Group Symbol is SP-SC')
   disp('Group Name = Poorly Graded Sand with Clay (or Silty Clay)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 6 & Cc < 1 & F1 >= 15
   class = strcat('the soil Group Symbol is SP-SC')
   disp('Group Name = Poorly Graded Sand with Clay  and Gravel (Silty Clay and Gravel)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 6 & Cc > 3 & F1 < 15
   class = strcat('the soil Group Symbol is SP-SC')
   disp('Group Name = Poorly Graded Sand with Clay (or Silty Clay)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay > silt & Cu < 6 & Cc > 3 & F1 >= 15
  class = strcat('the soil Group Symbol is SP-SC')
   disp('Group Name = Poorly Graded Sand with Clay  and Gravel (Silty Clay and Gravel)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu >= 6 & Cc >= 1 & Cc <= 3 & F1 < 15
    class = strcat('the soil Group Symbol is SW-SM')
   disp('Group Name = Well Graded Sand with Silt')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu >= 6 & Cc >= 1 & Cc <= 3 & F1 >= 15
```

```
    class = strcat('the soil Group Symbol is SW-SM')
   disp('Group Name = Well Graded Sand with Silt and Gravel')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 6 & Cc < 1 & F1 < 15
   class = strcat('the soil Group Symbol is SP-SM')
   disp('Group Name = Poorly Graded Sand with Silt')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 6 & Cc < 1 & F1 >= 15
   class = strcat('the soil Group Symbol is SP-SM')
   disp('Group Name = Poorly Graded Sand with Silt and gravel)')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 6 & Cc > 3 & F1 < 15
   class = strcat('the soil Group Symbol is SP-SM')
   disp('Group Name = Poorly Graded Sand with Silt')
elseif S1 > 50 & F1 < sandfraction & S2 >= 5 & S2 <= 12 & clay < silt & Cu < 6 & Cc > 3 & F1 >= 15
   class = strcat('the soil Group Symbol is SP-SM')
   disp('Group Name = Poorly Graded Sand with Silt and gravel)')
elseif S1 < 15 & LL < 50 & PI > 7 & PI >= ALine & S2 > 50 & LLR > 0.75
   class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Lean Clay')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay > silt & sandfraction >= F1
    class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Lean Clay with Sand')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay > silt & sandfraction < F1
    class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Lean Clay with Gravel')
elseif S1 >= 30 & LL < 50 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay > silt & sandfraction >= F1 & F1 < 15
    class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Sandy Lean Clay')
elseif S1 >= 30 & LL < 50 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay > silt & sandfraction >= F1 & F1 >= 15
    class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Sandy Lean Clay with Gravel')
elseif S1 >= 30 & LL < 50 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay > silt & sandfraction < F1 & sandfraction <
        15
   class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Gravelly Lean Clay')
elseif S1 >= 30 & LL < 50 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay > silt & sandfraction < F1 & sandfraction >=
        15
   class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Gravelly Lean Clay with Sand')
elseif S1 >= 30 & LL < 50 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay > silt & sandfraction < F1 & sandfraction <
        15
   class = strcat('the soil Group Symbol is CL')
   disp('Group Name = Gravelly Lean Clay')
elseif S1 < 15 & LL < 50 & PI >= 4 & PI <= 7 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay < silt
   class = strcat('the soil Group Symbol is CL-ML')
   disp('Group Name = Silty Clay')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI >= 4 & PI <= 7 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay < silt &
        sandfraction >= F1
   class = strcat('the soil Group Symbol is CL-ML')
   disp('Group Name = Silty Clay with Sand')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI >= 4 & PI <= 7 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay < silt &
        sandfraction < F1
   class = strcat('the soil Group Symbol is CL-ML')
   disp('Group Name = Silty Clay with Gravel')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= 7 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay < silt & sandfraction >=
        F1 & F1 < 15
   class = strcat('the soil Group Symbol is CL-ML')
   disp('Group Name = Sandy Silty Clay')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= 7 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay < silt & sandfraction >=
        F1 & F1 >= 15
   class = strcat('the soil Group Symbol is CL-ML')
   disp('Group Name = Sand Silty Clay with Gravel')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= 7 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay < silt & sandfraction <
        F1 & sandfraction < 15
   class = strcat('the soil Group Symbol is CL-ML')
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   disp('Group Name = Gravelly Silty Clay')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= 7 & PI >= ALine & S2 > 50 & LLR > 0.75 & clay < silt & sandfraction <
        F1 & sandfraction >= 15
   class = strcat('the soil Group Symbol is CL-ML')
   disp('Group Name = Gravelly Silty Clay with Sand')
elseif S1 < 15 & PI < 4 & PI < ALine & LL < 50 & LLR > 0.75 & clay < silt & S2 > 50
   class = strcat('the soil Group Symbol is ML')
   disp('Group Name = Silt')
elseif S1 >= 15 & S1 <= 29 & PI < 4 & PI < ALine & LL < 50 & LLR > 0.75 & clay < silt & sandfraction >= F1 & S2 >
        50
   class = strcat('the soil Group Symbol is ML')
   disp('Group Name = Silt with Sand')
elseif S1 >= 15 & S1 <= 29 & PI < 4 & PI < ALine & LL < 50 & LLR > 0.75 & clay < silt & sandfraction < F1 & S2 >
        50
   class = strcat('the soil Group Symbol is ML')
   disp('Group Name = Silt with Gravel')
elseif S1 >= 30  & PI < 4 & PI < ALine & LL < 50 & LLR > 0.75 & clay < silt & sandfraction >= F1 & F1 < 15 & S2 >
        50
   class = strcat('the soil Group Symbol is ML')
   disp('Group Name = Sandy Silt')
elseif S1 >= 30  & PI < 4 & PI < ALine & LL < 50 & LLR > 0.75 & clay < silt & sandfraction >= F1 & F1 >= 15 & S2 >
        50
   class = strcat('the soil Group Symbol is ML')
   disp('Group Name = Sandy Silt with Gravel')
elseif S1 >= 30  & PI < 4 & PI < ALine & LL < 50 & LLR > 0.75 & clay < silt & sandfraction < F1 & sandfraction < 15
        & S2 > 50
   class = strcat('the soil Group Symbol is ML')
   disp('Group Name = Gravelly Silt')
elseif S1 >= 30  & PI < 4 & PI < ALine & LL < 50 & LLR > 0.75 & clay < silt & sandfraction < F1 & sandfraction >=
        15 & S2 > 50
   class = strcat('the soil Group Symbol is ML')
   disp('Group Name = Gravelly Silt with Sand')
elseif S1 < 15 & PI >= ALine & LL >= 50 & clay > silt & LLR > 0.75 & S2 > 50
   class = strcat('the soil Group Symbol is CH')
   disp('Group Name = Fat Clay')
elseif S1 >= 15 & S1 <= 29 & PI >= ALine & LL >= 50 & clay > silt & LLR > 0.75 & sandfraction >= F1 & S2 > 50
   class = strcat('the soil Group Symbol is CH')
   disp('Group Name = Fat Clay with Sand')
elseif S1 >= 15 & S1 <= 29 & PI >= ALine & LL >= 50 & clay > silt & LLR > 0.75 & sandfraction < F1 & S2 > 50
   class = strcat('the soil Group Symbol is CH')
   disp('Group Name = Fat Clay with Gravel')
elseif S1 >= 30 & PI >= ALine & LL >= 50 & clay > silt & LLR > 0.75 & sandfraction >= F1 & F1 < 15 & S2 > 50
   class = strcat('the soil Group Symbol is CH')
   disp('Group Name = Sandy Fat Clay')
elseif S1 >= 30 & PI >= ALine & LL >= 50 & clay > silt & LLR > 0.75 & sandfraction >= F1 & F1 > 15 & S2 > 50
   class = strcat('the soil Group Symbol is CH')
   disp('Group Name = Sandy Fat Clay with Gravel')
elseif S1 >= 30 & PI >= ALine & LL >= 50 & clay > silt & LLR > 0.75 & sandfraction < F1 & sandfraction < 15 & S2
        > 50
   class = strcat('the soil Group Symbol is CH')
   disp('Group Name = Gravelly Fat Clay')
elseif S1 >= 30 & PI >= ALine & LL >= 50 & clay > silt & LLR > 0.75 & sandfraction < F1 & sandfraction >= 15 & S2
        > 50
   class = strcat('the soil Group Symbol is CH')
   disp('Group Name = Gravelly Fat Clay with Sand')
elseif S1 < 15 & PI < ALine & LL >= 50 & clay < silt & LLR > 0.75 & S2 > 50
   class = strcat('the soil Group Symbol is MH')
   disp('Group Name = Elastic Silt')
elseif S1 >= 15 & S1 <= 29 & PI < ALine & LL >= 50 & clay < silt & LLR > 0.75 & sandfraction >= F1 & S2 > 50
   class = strcat('the soil Group Symbol is MH')
   disp('Group Name = Elastic Silt with Sand')
elseif S1 >= 15 & S1 <= 29 & PI < ALine & LL >= 50 & clay < silt & LLR > 0.75 & sandfraction < F1 & S2 > 50
   class = strcat('the soil Group Symbol is MH')
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   disp('Group Name = Elastic Silt with gravel')
elseif S1 >= 30 & S2 > 50 & PI < ALine & LL >= 50 & clay < silt & LLR > 0.75 & sandfraction >= F1 & F1 < 15
   class = strcat('the soil Group Symbol is MH')
   disp('Group Name = Sandy Elastic Silty')
elseif S1 >= 30 & S2 > 50 & PI < ALine & LL >= 50 & clay < silt & LLR > 0.75 & sandfraction >= F1 & F1 >= 15
   class = strcat('the soil Group Symbol is MH')
   disp('Group Name = Sandy Elastic Silt with Gravel')
elseif S1 >= 30 & S2 > 50 & PI < ALine & LL >= 50 & clay < silt & LLR > 0.75 & sandfraction < F1 & sandfraction <
          15
   class = strcat('the soil Group Symbol is MH')
   disp('Group Name = Gravelly Elastic Silt')
elseif S1 >= 30 & S2 > 50 & PI < ALine & LL >= 50 & clay < silt & LLR > 0.75 & sandfraction < F1 & sandfraction >=
          15
   class = strcat('the soil Group Symbol is MH')
   disp('Group Name = Gravelly Elastic Silt with Sand')
elseif S1 < 15 & LL < 50 & PI >= 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & S2 > 50
   class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Organic Clay')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI >= 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Organic Clay with Sand')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI >= 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Organic Clay with Gravel')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 < 15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Sandy Organic Clay')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 >= 15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Sandy Organic Clay with Gravel')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction <
          15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Gravelly Organic Clay')
elseif S1 >= 30 & LL < 50 & PI >= 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction >=
          15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Gravelly Organic Clay with Sand')
elseif S1 < 15 & LL < 50 & PI < 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & S2 > 50
   class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Organic Silt')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI < 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Organic Silt with Sand')
elseif S1 >= 15 & S1 <= 29 & LL < 50 & PI < 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Organic Silt with Gravel')
elseif S1 >= 30 & LL < 50 & PI < 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 < 15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Sandy Organic Silt')
elseif S1 >= 30 & LL < 50 & PI < 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 >= 15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Sandy Organic Silt with Gravel')
elseif S1 >= 30 & LL < 50 & PI < 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction < 15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Gravelly Organic Silt')
elseif S1 >= 30 & LL < 50 & PI < 4 & PI <= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction >=
          15
    class = strcat('the soil Group Symbol is OL')
   disp('Group Name = Gravelly Organic Silt with Sand')
elseif S1 < 15 & LL >= 50 & PI >= ALine & S2 > 50 & LLR <= 0.75
   class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Organic Clay')
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elseif S1 >= 15 & S1 <= 29 & LL >= 50 & PI >= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Organic Clay with Sand')
elseif S1 >= 15 & S1 <= 29 & LL >= 50 & PI >= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Organic Clay with Gravel')
elseif S1 >= 30 & LL >= 50 & PI >= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 < 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Sandy Organic Clay')
elseif S1 >= 30 & LL >= 50 & PI >= ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 >= 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Sandy Organic Clay with Gravel')
elseif S1 >= 30 & LL >= 50 & PI >= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction < 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Gravelly Organic Clay')
elseif S1 >= 30 & LL >= 50 & PI >= ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction >= 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Gravelly Organic Clay with Sand')
elseif S1 < 15 & LL >= 50 & PI < ALine & S2 > 50 & LLR <= 0.75 & S2 > 50
   class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Organic Silt')
elseif S1 >= 15 & S1 <= 29 & LL >= 50 & PI < ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Organic Silt with Sand')
elseif S1 >= 15 & S1 <= 29 & LL >= 50 & PI < ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Organic Silt with Gravel')
elseif S1 >= 30 & LL >= 50 & PI < ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 < 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Sandy Organic Silt')
elseif S1 >= 30 & LL >= 50 & PI < ALine & S2 > 50 & LLR <= 0.75 & sandfraction >= F1 & F1 >= 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Sandy Organic Silt with Gravel')
elseif S1 >= 30 & LL >= 50 & PI < ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction < 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Gravelly Organic Silt')
elseif S1 >= 30 & LL >= 50 & PI < ALine & S2 > 50 & LLR <= 0.75 & sandfraction < F1 & sandfraction >= 15
    class = strcat('the soil Group Symbol is OH')
   disp('Group Name = Gravelly Organic Silt with Sand')
else
end
else
   disp('WARNING: You select a number out of range, if you still want continue indicate and select between 1 to 5')
end
m=input('Do you want to continue, Y/N [Y]:','s')
if m=='N'
break
end
end
end
```