

Parte 1 (Baterias de 1 a 5)

(Debug) In[2604]:=

```
v1 = .5;
```

(Debug) In[2605]:=

```
bat1 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt1\\BAT1.xls"];
d1 = 13.16;
h1 = 30.83;
fTAV1 = Table[{bat1[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d12 (* A[mm2] *), v1 (* v[mm/s] *)}, {i, 1, Length[bat1]}];
deltaSt1 = Table[{fTAV1[[i]][[2]] fTAV1[[i]][[4]], fTAV1[[i]][[1]] / fTAV1[[i]][[3]]},
  {i, 1, Length[bat1]}];
strainStress1 = Table[{deltaSt1[[i]][[1]] / h1, deltaSt1[[i]][[2]]},
  {i, 1, Length[bat1]}];
strainStressFit1 = Table[{deltaSt1[[i]][[1]] / h1, deltaSt1[[i]][[2]]}, {i, 80, 200}];
g1 = ListPlot[strainStress1, PlotStyle -> {Red, PointSize[.005]}];
```

(Debug) In[2613]:=

```
bat2 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt1\\BAT2.xls"];
d2 = 12.89;
h2 = 31.34;
fTAV2 = Table[{bat2[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d22 (* A[mm2] *), v1 (* v[mm/s] *)}, {i, 1, Length[bat2]}];
deltaSt2 = Table[{fTAV2[[i]][[2]] fTAV2[[i]][[4]], fTAV2[[i]][[1]] / fTAV2[[i]][[3]]},
  {i, 1, Length[bat2]}];
strainStress2 = Table[{deltaSt2[[i]][[1]] / h2, deltaSt2[[i]][[2]]},
  {i, 1, Length[bat2]}];
strainStressFit2 = Table[{deltaSt2[[i]][[1]] / h2, deltaSt2[[i]][[2]]}, {i, 100, 200}];
g2 = ListPlot[strainStress2, PlotStyle -> {Purple, PointSize[.005]}];
```

(Debug) In[2621]:=

```
bat3 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt1\\BAT3.xls"];
d3 = 13.2;
h3 = 30.84;
fTAV3 = Table[{bat3[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d32 (* A[mm2] *), v1 (* v[mm/s] *)}, {i, 1, Length[bat3]}];
deltaSt3 = Table[{fTAV3[[i]][[2]] fTAV3[[i]][[4]], fTAV3[[i]][[1]] / fTAV3[[i]][[3]]},
  {i, 1, Length[bat3]}];
strainStress3 = Table[{deltaSt3[[i]][[1]] / h3, deltaSt3[[i]][[2]]},
  {i, 1, Length[bat3]}];
strainStressFit3 = Table[{deltaSt3[[i]][[1]] / h3, deltaSt3[[i]][[2]]}, {i, 100, 200}];
g3 = ListPlot[strainStress3, PlotStyle -> {Blue, PointSize[.005]}];
```

(Debug) In[2629]:=

```

bat4 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt1\\BAT4.xls"];
d4 = 13.25;
h4 = 31.8;
fTAV4 = Table[{bat4[[i]][[1]] 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d42 (* A[mm2] *), v1 (* v[mm/s] *)}, {i, 1, Length[bat4]};
deltaSt4 = Table[{fTAV4[[i]][[2]] fTAV4[[i]][[4]], fTAV4[[i]][[1]] / fTAV4[[i]][[3]]},
  {i, 1, Length[bat4]};
strainStress4 = Table[{deltaSt4[[i]][[1]] / h4, deltaSt4[[i]][[2]]},
  {i, 1, Length[bat4]};
strainStressFit4 = Table[{deltaSt4[[i]][[1]] / h4, deltaSt4[[i]][[2]]}, {i, 100, 200}];
g4 = ListPlot[strainStress4, PlotStyle → {Orange, PointSize[.005]}];

```

(Debug) In[2637]:=

```

bat5 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt1\\BAT5.xls"];
d5 = 13.2;
h5 = 30.84;
fTAV5 = Table[{bat5[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d52 (* A[mm2] *), v1 (* v[mm/s] *)}, {i, 1, Length[bat5]};
deltaSt5 = Table[{fTAV5[[i]][[2]] fTAV5[[i]][[4]], fTAV5[[i]][[1]] / fTAV5[[i]][[3]]},
  {i, 1, Length[bat5]};
strainStress5 = Table[{deltaSt5[[i]][[1]] / h5, deltaSt5[[i]][[2]]},
  {i, 1, Length[bat5]};
strainStressFit5 = Table[{deltaSt5[[i]][[1]] / h5, deltaSt5[[i]][[2]]}, {i, 100, 200}];
g5 = ListPlot[strainStress5, PlotStyle → {Magenta, PointSize[.005]}];

pointsSet1 = Join[strainStressFit1, strainStressFit2,
  strainStressFit3, strainStressFit4, strainStressFit5];
line1 = Fit[pointsSet1, {1, x}, x] (* Daqui tiramos que E = 3.22 MPa*)

```

(Debug) Out[2646]=

```

- 0.321001 + 3.21877 x

```

(Debug) In[2647]:=

```

dP1 = StandardDeviation[pointsSet1]

```

(Debug) Out[2647]=

```

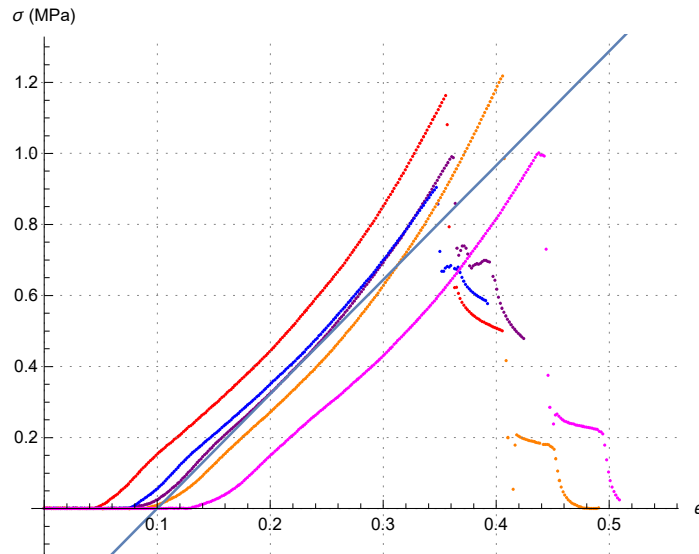
{0.04963, 0.197507}

```

(Debug) In[2648]:=

```
Show[ContourPlot[y == 10, {x, .0, .55}, {y, -.1, 1.3}, GridLines -> Automatic,
  GridLinesStyle -> {{Gray, Dotted}, {Gray, Dotted}}, g1, g2,
  g3, g4, g5, Plot[line1, {x, -.3, .7}, PlotStyle -> {Thickness[.004]}],
  AspectRatio -> .8, Axes -> True, Frame -> False, AxesLabel -> {"ε", "σ (MPa)"}]
```

(Debug) Out[2648]=



Parte 2 (Baterias de 6 a 10)

(Debug) In[2649]:=

```
v2 = .8;
```

(Debug) In[2650]:=

```
bat6 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt2\\BAT6.xls"];
d6 = 12.81;
h6 = 30.75;
fTAV6 = Table[{bat6[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d6^2 (* A[mm^2] *), v2 (* v[mm/s] *)}, {i, 1, Length[bat6]}];
deltaSt6 = Table[{fTAV6[[i]][[2]] fTAV6[[i]][[4]], fTAV6[[i]][[1]] / fTAV6[[i]][[3]]},
  {i, 1, Length[bat6]}];
strainStress6 = Table[{deltaSt6[[i]][[1]] / h6, deltaSt6[[i]][[2]]},
  {i, 1, Length[bat6]}];
strainStressFit6 = Table[{deltaSt6[[i]][[1]] / h6, deltaSt6[[i]][[2]]}, {i, 60, 130}];
g6 = ListPlot[strainStress6, PlotStyle -> {Red, PointSize[.005]}];
```

(Debug) In[2658]:=

```

bat7 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt2\\BAT7.xls"];
d7 = 12.89;
h7 = 31.78;
fTAV7 = Table[{bat7[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d72 (* A[mm2] *), v2 (* v[mm/s] *)}, {i, 1, Length[bat7]}];
deltaSt7 = Table[{fTAV7[[i]][[2]] fTAV7[[i]][[4]], fTAV7[[i]][[1]] / fTAV7[[i]][[3]]},
  {i, 1, Length[bat7]}];
strainStress7 = Table[{deltaSt7[[i]][[1]] / h7, deltaSt7[[i]][[2]]},
  {i, 1, Length[bat7]}];
strainStressFit7 = Table[{deltaSt7[[i]][[1]] / h7, deltaSt7[[i]][[2]]}, {i, 60, 130}];
g7 = ListPlot[strainStress7, PlotStyle → {Magenta, PointSize[.005]}];

```

(Debug) In[2666]:=

```

bat8 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt2\\BAT8.xls"];
d8 = 13.44;
h8 = 31.14;
fTAV8 = Table[{bat8[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d82 (* A[mm2] *), v2 (* v[mm/s] *)}, {i, 1, Length[bat8]}];
deltaSt8 = Table[{fTAV8[[i]][[2]] fTAV8[[i]][[4]], fTAV8[[i]][[1]] / fTAV8[[i]][[3]]},
  {i, 1, Length[bat8]}];
strainStress8 = Table[{deltaSt8[[i]][[1]] / h8, deltaSt8[[i]][[2]]},
  {i, 1, Length[bat8]}];
strainStressFit8 = Table[{deltaSt8[[i]][[1]] / h8, deltaSt8[[i]][[2]]}, {i, 60, 130}];
g8 = ListPlot[strainStress8, PlotStyle → {Blue, PointSize[.005]}];

```

(Debug) In[2674]:=

```

bat9 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt2\\BAT9.xls"];
d9 = 13.6;
h9 = 30.91;
fTAV9 = Table[{bat9[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d92 (* A[mm2] *), v2 (* v[mm/s] *)}, {i, 1, Length[bat9]}];
deltaSt9 = Table[{fTAV9[[i]][[2]] fTAV9[[i]][[4]], fTAV9[[i]][[1]] / fTAV9[[i]][[3]]},
  {i, 1, Length[bat9]}];
strainStress9 = Table[{deltaSt9[[i]][[1]] / h9, deltaSt9[[i]][[2]]},
  {i, 1, Length[bat9]}];
strainStressFit9 = Table[{deltaSt9[[i]][[1]] / h9, deltaSt9[[i]][[2]]}, {i, 60, 130}];
g9 = ListPlot[strainStress9, PlotStyle → {Red, PointSize[.005]}];

```

(Debug) In[2682]:=

```

bat10 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt2\\BAT10.xls"];
d10 = 13.52;
h10 = 31.03;
fTAV10 = Table[{bat10[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d102 (* A[mm2] *), v2 (* v[mm/s] *)}, {i, 1, Length[bat10]}];
deltaSt10 = Table[{fTAV10[[i]][[2]] fTAV10[[i]][[4]],
  fTAV10[[i]][[1]] / fTAV10[[i]][[3]]}, {i, 1, Length[bat10]}];
strainStress10 = Table[{deltaSt10[[i]][[1]] / h10, deltaSt10[[i]][[2]]},
  {i, 1, Length[bat10]}];
strainStressFit10 = Table[{deltaSt10[[i]][[1]] / h10, deltaSt10[[i]][[2]]},
  {i, 60, 130}];
g10 = ListPlot[strainStress10, PlotStyle -> {Green, PointSize[.005]}];

```

(Debug) In[2690]:=

```

pointsSet2 = Join[strainStressFit6, strainStressFit7,
  strainStressFit8, strainStressFit9, strainStressFit10];
line2 = Fit[pointsSet2, {1, x}, x] (* Daqui tiramos que E = 3.54 MPa*)

```

(Debug) Out[2691]=

```
-0.370173 + 3.5426 x
```

(Debug) In[2692]:=

```
dP2 = StandardDeviation[pointsSet2]
```

(Debug) Out[2692]=

```
{0.0528346, 0.213888}
```

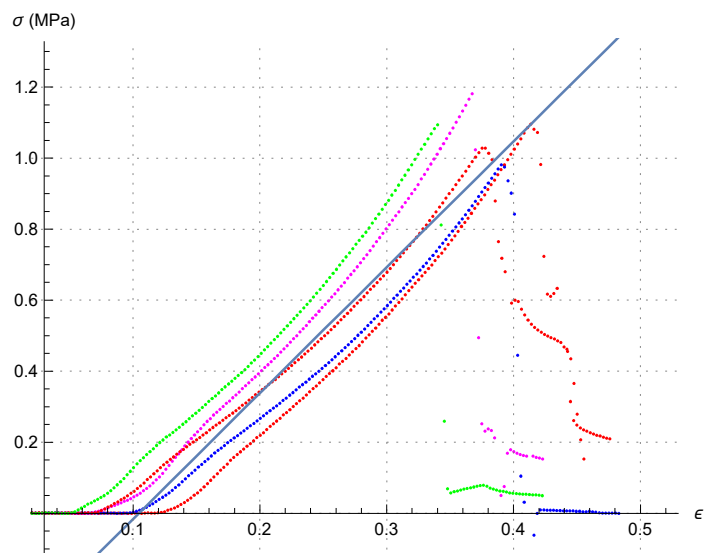
(Debug) In[2693]:=

```

Show[ContourPlot[y == 10, {x, .03, .52}, {y, -.1, 1.3}, GridLines -> Automatic,
  GridLinesStyle -> {{Gray, Dotted}, {Gray, Dotted}}, g6, g7, g8,
  g9, g10, Plot[line2, {x, -.3, .7}, PlotStyle -> {Thickness[.004]}],
  AspectRatio -> .8, Axes -> True, Frame -> False, AxesLabel -> {"ε", "σ (MPa)"}]

```

(Debug) Out[2693]=



Parte 3 (Baterias de 11 a 15)

(Debug) In[2694]:=

```
v3 = 1.2;
```

(Debug) In[2695]:=

```

bat11 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt3\\BAT11.xls"];
d11 = 13.15;
h11 = 31.5;
fTAV11 = Table[{bat11[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d112 (* A[mm2] *), v3 (* v[mm/s] *)}, {i, 1, Length[bat11]}];
deltaSt11 = Table[{fTAV11[[i]][[2]] fTAV11[[i]][[4]],
  fTAV11[[i]][[1]] / fTAV11[[i]][[3]]}, {i, 1, Length[bat11]}];
strainStress11 = Table[{deltaSt11[[i]][[1]] / h11, deltaSt11[[i]][[2]]},
  {i, 1, Length[bat11]}];
strainStressFit11 = Table[{deltaSt11[[i]][[1]] / h11, deltaSt11[[i]][[2]]},
  {i, 80, 100}];
g11 = ListPlot[strainStress11, PlotStyle → {Green, PointSize[.005]}];

```

(Debug) In[2703]:=

```

bat12 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt3\\BAT12.xls"];
d12 = 13.15;
h12 = 31.5;
fTAV12 = Table[{bat12[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d122 (* A[mm2] *), v3 (* v[mm/s] *)}, {i, 1, Length[bat12]}];
deltaSt12 = Table[{fTAV12[[i]][[2]] fTAV12[[i]][[4]],
  fTAV12[[i]][[1]] / fTAV12[[i]][[3]]}, {i, 1, Length[bat12]}];
strainStress12 = Table[{deltaSt12[[i]][[1]] / h12, deltaSt12[[i]][[2]]},
  {i, 1, Length[bat12]}];
strainStressFit12 = Table[{deltaSt12[[i]][[1]] / h12, deltaSt12[[i]][[2]]},
  {i, 80, 100}];
g12 = ListPlot[strainStress12, PlotStyle → {Magenta, PointSize[.005]}];

```

(Debug) In[2711]:=

```

bat13 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt3\\BAT13.xls"];
d13 = 13.53;
h13 = 30.71;
fTAV13 = Table[{bat13[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d132 (* A[mm2] *), v3 (* v[mm/s] *)}, {i, 1, Length[bat13]}];
deltaSt13 = Table[{fTAV13[[i]][[2]] fTAV13[[i]][[4]],
  fTAV13[[i]][[1]] / fTAV13[[i]][[3]]}, {i, 1, Length[bat13]}];
strainStress13 = Table[{deltaSt13[[i]][[1]] / h13, deltaSt13[[i]][[2]]},
  {i, 1, Length[bat13]}];
strainStressFit13 = Table[{deltaSt13[[i]][[1]] / h13, deltaSt13[[i]][[2]]},
  {i, 80, 100}];
g13 = ListPlot[strainStress13, PlotStyle → {Orange, PointSize[.005]}];

```

(Debug) In[2719]:=

```

bat14 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt3\\BAT14.xls"];
d14 = 13.32;
h14 = 30.71;
fTAV14 = Table[{bat14[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d142 (* A[mm2] *), v3 (* v[mm/s] *)}, {i, 1, Length[bat14]}];
deltaSt14 = Table[{fTAV14[[i]][[2]] fTAV14[[i]][[4]],
  fTAV14[[i]][[1]] / fTAV14[[i]][[3]]}, {i, 1, Length[bat14]}];
strainStress14 = Table[{deltaSt14[[i]][[1]] / h14, deltaSt14[[i]][[2]]},
  {i, 1, Length[bat14]}];
strainStressFit14 = Table[{deltaSt14[[i]][[1]] / h14, deltaSt14[[i]][[2]]},
  {i, 80, 100}];
g14 = ListPlot[strainStress14, PlotStyle → {Blue, PointSize[.005]}];

```

(Debug) In[2727]:=

```

bat15 = Import["C:\\Users\\renan\\Desktop\\576\\stages\\xls\\pt3\\BAT15.xls"];
d15 = 13.28;
h15 = 32.51;
fTAV15 = Table[{bat15[[i]][[1]] * 9.81 (* F[N] *), N[(i - 1) / 10] (* t[s] *),
  (Pi / 4) * d152 (* A[mm2] *), v3 (* v[mm/s] *)}, {i, 1, Length[bat15]}];
deltaSt15 = Table[{fTAV15[[i]][[2]] fTAV15[[i]][[4]],
  fTAV15[[i]][[1]] / fTAV15[[i]][[3]]}, {i, 1, Length[bat15]}];
strainStress15 = Table[{deltaSt15[[i]][[1]] / h15, deltaSt15[[i]][[2]]},
  {i, 1, Length[bat15]}];
strainStressFit15 = Table[{deltaSt15[[i]][[1]] / h15, deltaSt15[[i]][[2]]},
  {i, 80, 100}];
g15 = ListPlot[strainStress15, PlotStyle → {Red, PointSize[.005]}];

```

(Debug) In[2735]:=

```

pointsSet3 = Join[strainStressFit11, strainStressFit12,
  strainStressFit13, strainStressFit14, strainStressFit15];
line3 = Fit[pointsSet3, {1, x}, x] (* Daqui tiramos que E = 3.77 MPa*)

```

(Debug) Out[2736]=

```

- 0.852542 + 3.77474 x

```

(Debug) In[2737]:=

```

dP3 = StandardDeviation[pointsSet3]

```

(Debug) Out[2737]=

```

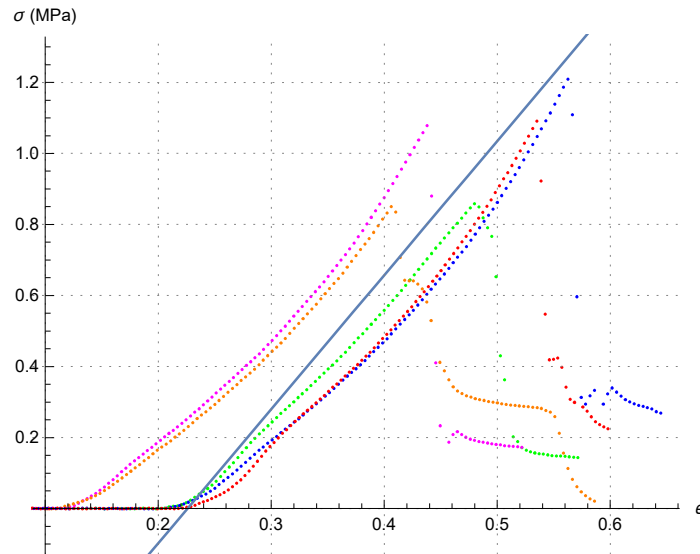
{0.0243529, 0.167873}

```

(Debug) In[2738]:=

```
Show[ContourPlot[y == 10, {x, .1, .65}, {y, -.1, 1.3}, GridLines -> Automatic,
  GridLinesStyle -> {{Gray, Dotted}, {Gray, Dotted}}, g11, g12,
  g13, g14, g15, Plot[line3, {x, -.3, .7}, PlotStyle -> {Thickness[.004]}],
  AspectRatio -> .8, Axes -> True, Frame -> False, AxesLabel -> {"ε", "σ (MPa)"}]
```

(Debug) Out[2738]=



Correlacionando os módulos de elasticidade com a velocidade de deformação

(Debug) In[2739]:=

```
vE = {{v1, line1[[2, 1]]}, {v2, line2[[2, 1]]}, {v3, line3[[2, 1]]}};
```

(Debug) In[2740]:=

```
g = Simplify[InterpolatingPolynomial[vE, x]]
```

(Debug) Out[2740]=

```
2.39383 + 2.00638 x - 0.713018 x^2
```

(Debug) In[2741]:=

```
Show[Plot[g, {x, 0, 1.5}, GridLines -> Automatic,
  GridLinesStyle -> {{Gray, Dotted}, {Gray, Dotted}},
  AxesLabel -> {"v (mm/s)", "E (MPa)"},
  ListPlot[vE, PlotStyle -> {Red, PointSize[Large]}]]
```

(Debug) Out[2741]=

