

2019

# Fire safety of rectangular hollow section (RHS) truss members with local imperfections

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# Appendix 1

## Fire Limit State Connection Loaded Model Results (Connection Loading = 22kN):

Room  
Temperature  
(RT)

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 6.38E-08       | 1.37E-06 |
| 4.00E-02 | 1.28E-07       | 2.75E-06 |
| 7.00E-02 | 2.23E-07       | 4.81E-06 |
| 0.115    | 3.67E-07       | 7.90E-06 |
| 0.1825   | 5.82E-07       | 1.25E-05 |
| 0.2825   | 9.00E-07       | 1.94E-05 |
| 0.3825   | 1.22E-06       | 2.63E-05 |
| 0.4825   | 1.54E-06       | 3.32E-05 |
| 0.5825   | 1.85E-06       | 4.01E-05 |
| 0.6825   | 2.17E-06       | 4.70E-05 |
| 0.7825   | 2.49E-06       | 5.38E-05 |
| 0.8825   | 2.81E-06       | 6.07E-05 |
| 0.9825   | 3.12E-06       | 6.77E-05 |
| 1.0825   | 8.17E-08       | 6.59E-05 |
| 1.1825   | 4.91E-06       | 6.76E-05 |
| 1.2825   | 9.46E-06       | 8.70E-05 |
| 1.3825   | 1.40E-05       | 1.19E-04 |
| 1.4825   | 1.85E-05       | 1.51E-04 |
| 1.5825   | 2.30E-05       | 1.84E-04 |
| 1.6825   | 2.75E-05       | 2.18E-04 |
| 1.7825   | 3.20E-05       | 2.52E-04 |
| 1.8825   | 3.64E-05       | 2.86E-04 |
| 1.9413   | 3.90E-05       | 3.07E-04 |
| 2        | 4.17E-05       | 3.27E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 2.22E-02    | 3.55E+06 |
| 4.00E-02 | 4.72E-02    | 7.09E+06 |
| 7.00E-02 | 9.12E-02    | 1.24E+07 |
| 0.115    | 1.75E-01    | 2.04E+07 |
| 0.1825   | 3.37E-01    | 3.24E+07 |
| 0.2825   | 6.60E-01    | 5.01E+07 |
| 0.3825   | 0.99905     | 6.79E+07 |
| 0.4825   | 1.3697      | 8.57E+07 |
| 0.5825   | 1.458       | 1.03E+08 |
| 0.6825   | 1.5007      | 1.21E+08 |
| 0.7825   | 1.7169      | 1.39E+08 |
| 0.8825   | 2.3766      | 1.57E+08 |
| 0.9825   | 3.5855      | 1.75E+08 |
| 1.0825   | 225.34      | 1.77E+08 |
| 1.1825   | 230.44      | 1.77E+08 |
| 1.2825   | 230.58      | 1.77E+08 |
| 1.3825   | 230.41      | 1.77E+08 |
| 1.4825   | 230.08      | 1.77E+08 |
| 1.5825   | 229.82      | 1.77E+08 |
| 1.6825   | 229.59      | 1.77E+08 |
| 1.7825   | 229.32      | 1.77E+08 |
| 1.8825   | 229.01      | 1.77E+08 |
| 1.9413   | 228.93      | 1.77E+08 |
| 2        | 228.83      | 1.77E+08 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.36E-13     | 1.77E-05 |
| 4.00E-02 | 2.95E-13     | 3.55E-05 |
| 7.00E-02 | 5.86E-13     | 6.21E-05 |
| 0.115    | 1.15E-12     | 1.02E-04 |
| 0.1825   | 2.27E-12     | 1.62E-04 |
| 0.2825   | 4.57E-12     | 2.51E-04 |
| 0.3825   | 7.80E-12     | 3.40E-04 |
| 0.4825   | 1.19E-11     | 4.29E-04 |
| 0.5825   | 1.74E-11     | 5.18E-04 |
| 0.6825   | 2.46E-11     | 6.07E-04 |
| 0.7825   | 3.39E-11     | 6.96E-04 |
| 0.8825   | 4.52E-11     | 7.85E-04 |
| 0.9825   | 6.02E-11     | 8.74E-04 |
| 1.0825   | 1.14E-09     | 8.88E-04 |
| 1.1825   | 1.16E-09     | 8.86E-04 |
| 1.2825   | 1.16E-09     | 8.86E-04 |
| 1.3825   | 1.16E-09     | 8.86E-04 |
| 1.4825   | 1.16E-09     | 8.85E-04 |
| 1.5825   | 1.16E-09     | 8.85E-04 |
| 1.6825   | 1.16E-09     | 8.85E-04 |
| 1.7825   | 1.16E-09     | 8.84E-04 |
| 1.8825   | 1.16E-09     | 8.84E-04 |
| 1.9413   | 1.16E-09     | 8.84E-04 |
| 2        | 1.16E-09     | 8.84E-04 |

300°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 7.98E-08       | 1.72E-06 |
| 4.00E-02 | 1.60E-07       | 3.43E-06 |
| 7.00E-02 | 2.79E-07       | 6.01E-06 |
| 0.115    | 4.58E-07       | 9.87E-06 |
| 0.1825   | 7.27E-07       | 1.57E-05 |
| 0.2825   | 1.13E-06       | 2.43E-05 |
| 0.3825   | 1.52E-06       | 3.29E-05 |
| 0.4825   | 1.92E-06       | 4.15E-05 |
| 0.5825   | 2.32E-06       | 5.01E-05 |
| 0.6825   | 2.71E-06       | 5.87E-05 |
| 0.7825   | 3.11E-06       | 6.73E-05 |
| 0.8825   | 3.51E-06       | 7.60E-05 |
| 0.9825   | 3.90E-06       | 8.46E-05 |
| 1.0825   | 1.97E-07       | 8.26E-05 |
| 1.1825   | 6.19E-06       | 8.55E-05 |
| 1.2825   | 1.18E-05       | 1.06E-04 |
| 1.3825   | 1.74E-05       | 1.45E-04 |
| 1.4825   | 2.30E-05       | 1.85E-04 |
| 1.5825   | 2.86E-05       | 2.26E-04 |
| 1.6825   | 3.42E-05       | 2.67E-04 |
| 1.7825   | 3.98E-05       | 3.10E-04 |
| 1.8825   | 4.54E-05       | 3.53E-04 |
| 1.9413   | 4.87E-05       | 3.79E-04 |
| 2        | 5.20E-05       | 4.05E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 2.25E-02    | 3.55E+06 |
| 4.00E-02 | 4.90E-02    | 7.09E+06 |
| 7.00E-02 | 9.72E-02    | 1.24E+07 |
| 0.115    | 1.92E-01    | 2.04E+07 |
| 0.1825   | 3.75E-01    | 3.24E+07 |
| 0.2825   | 7.13E-01    | 5.01E+07 |
| 0.3825   | 1.0852      | 6.79E+07 |
| 0.4825   | 1.1891      | 8.57E+07 |
| 0.5825   | 1.2539      | 1.03E+08 |
| 0.6825   | 1.6476      | 1.21E+08 |
| 0.7825   | 2.7062      | 1.39E+08 |
| 0.8825   | 3.8521      | 1.57E+08 |
| 0.9825   | 5.5199      | 1.75E+08 |
| 1.0825   | 280.8       | 1.78E+08 |
| 1.1825   | 288.3       | 1.78E+08 |
| 1.2825   | 288.12      | 1.78E+08 |
| 1.3825   | 287.81      | 1.78E+08 |
| 1.4825   | 287.29      | 1.77E+08 |
| 1.5825   | 286.69      | 1.77E+08 |
| 1.6825   | 286.13      | 1.77E+08 |
| 1.7825   | 285.59      | 1.77E+08 |
| 1.8825   | 285.01      | 1.77E+08 |
| 1.9413   | 284.83      | 1.77E+08 |
| 2        | 284.63      | 1.77E+08 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.73E-13     | 2.22E-05 |
| 4.00E-02 | 3.86E-13     | 4.44E-05 |
| 7.00E-02 | 7.88E-13     | 7.77E-05 |
| 0.115    | 1.60E-12     | 1.28E-04 |
| 0.1825   | 3.21E-12     | 2.03E-04 |
| 0.2825   | 6.76E-12     | 3.14E-04 |
| 0.3825   | 1.15E-11     | 4.25E-04 |
| 0.4825   | 1.84E-11     | 5.36E-04 |
| 0.5825   | 2.80E-11     | 6.47E-04 |
| 0.6825   | 4.08E-11     | 7.59E-04 |
| 0.7825   | 5.77E-11     | 8.70E-04 |
| 0.8825   | 8.07E-11     | 9.82E-04 |
| 0.9825   | 1.13E-10     | 1.09E-03 |
| 1.0825   | 1.77E-09     | 1.11E-03 |
| 1.1825   | 1.82E-09     | 1.11E-03 |
| 1.2825   | 1.82E-09     | 1.11E-03 |
| 1.3825   | 1.82E-09     | 1.11E-03 |
| 1.4825   | 1.81E-09     | 1.11E-03 |
| 1.5825   | 1.81E-09     | 1.11E-03 |
| 1.6825   | 1.81E-09     | 1.11E-03 |
| 1.7825   | 1.80E-09     | 1.11E-03 |
| 1.8825   | 1.80E-09     | 1.11E-03 |
| 1.9413   | 1.80E-09     | 1.11E-03 |
| 2        | 1.80E-09     | 1.11E-03 |

400°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 9.11E-08       | 1.96E-06 |
| 4.00E-02 | 1.82E-07       | 3.92E-06 |
| 7.00E-02 | 3.19E-07       | 6.87E-06 |
| 0.115    | 5.24E-07       | 1.13E-05 |
| 0.1825   | 8.31E-07       | 1.79E-05 |
| 0.2825   | 1.29E-06       | 2.77E-05 |
| 0.3825   | 1.74E-06       | 3.76E-05 |
| 0.4825   | 2.19E-06       | 4.74E-05 |
| 0.5825   | 2.65E-06       | 5.73E-05 |
| 0.6825   | 3.10E-06       | 6.71E-05 |
| 0.7825   | 3.55E-06       | 7.70E-05 |
| 0.8825   | 4.00E-06       | 8.69E-05 |
| 0.9825   | 4.46E-06       | 9.68E-05 |
| 1.0825   | 3.92E-07       | 9.48E-05 |
| 1.1825   | 7.08E-06       | 9.95E-05 |
| 1.2825   | 1.35E-05       | 1.17E-04 |
| 1.3825   | 2.00E-05       | 1.60E-04 |
| 1.4825   | 2.64E-05       | 2.03E-04 |
| 1.5825   | 3.28E-05       | 2.47E-04 |
| 1.6825   | 3.92E-05       | 2.93E-04 |
| 1.7825   | 4.56E-05       | 3.39E-04 |
| 1.8825   | 5.20E-05       | 3.86E-04 |
| 1.9413   | 5.57E-05       | 4.15E-04 |
| 2        | 5.94E-05       | 4.43E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 2.28E-02    | 3.55E+06 |
| 4.00E-02 | 4.99E-02    | 7.09E+06 |
| 7.00E-02 | 1.01E-01    | 1.24E+07 |
| 0.115    | 2.03E-01    | 2.04E+07 |
| 0.1825   | 4.05E-01    | 3.24E+07 |
| 0.2825   | 7.44E-01    | 5.01E+07 |
| 0.3825   | 1.0342      | 6.79E+07 |
| 0.4825   | 1.0744      | 8.57E+07 |
| 0.5825   | 1.3243      | 1.04E+08 |
| 0.6825   | 2.268       | 1.21E+08 |
| 0.7825   | 3.4246      | 1.39E+08 |
| 0.8825   | 5.1452      | 1.57E+08 |
| 0.9825   | 8.0708      | 1.75E+08 |
| 1.0825   | 319.26      | 1.78E+08 |
| 1.1825   | 329.85      | 1.78E+08 |
| 1.2825   | 328.89      | 1.78E+08 |
| 1.3825   | 327.88      | 1.78E+08 |
| 1.4825   | 326.83      | 1.78E+08 |
| 1.5825   | 325.75      | 1.78E+08 |
| 1.6825   | 324.65      | 1.78E+08 |
| 1.7825   | 323.55      | 1.78E+08 |
| 1.8825   | 322.45      | 1.78E+08 |
| 1.9413   | 322.09      | 1.78E+08 |
| 2        | 321.71      | 1.78E+08 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 2.01E-13     | 2.54E-05 |
| 4.00E-02 | 4.54E-13     | 5.07E-05 |
| 7.00E-02 | 9.45E-13     | 8.88E-05 |
| 0.115    | 1.94E-12     | 1.46E-04 |
| 0.1825   | 3.99E-12     | 2.32E-04 |
| 0.2825   | 8.44E-12     | 3.59E-04 |
| 0.3825   | 1.48E-11     | 4.86E-04 |
| 0.4825   | 2.43E-11     | 6.13E-04 |
| 0.5825   | 3.78E-11     | 7.40E-04 |
| 0.6825   | 5.61E-11     | 8.67E-04 |
| 0.7825   | 8.19E-11     | 9.95E-04 |
| 0.8825   | 1.19E-10     | 1.12E-03 |
| 0.9825   | 1.62E-10     | 1.25E-03 |
| 1.0825   | 2.31E-09     | 1.27E-03 |
| 1.1825   | 2.38E-09     | 1.27E-03 |
| 1.2825   | 2.38E-09     | 1.27E-03 |
| 1.3825   | 2.37E-09     | 1.27E-03 |
| 1.4825   | 2.37E-09     | 1.27E-03 |
| 1.5825   | 2.36E-09     | 1.27E-03 |
| 1.6825   | 2.35E-09     | 1.27E-03 |
| 1.7825   | 2.34E-09     | 1.27E-03 |
| 1.8825   | 2.34E-09     | 1.27E-03 |
| 1.9413   | 2.33E-09     | 1.27E-03 |
| 2        | 2.33E-09     | 1.27E-03 |

500°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 1.06E-07       | 2.29E-06 |
| 4.00E-02 | 2.13E-07       | 4.58E-06 |
| 7.00E-02 | 3.72E-07       | 8.01E-06 |
| 0.115    | 6.11E-07       | 1.32E-05 |
| 0.1825   | 9.69E-07       | 2.09E-05 |
| 0.2825   | 1.50E-06       | 3.24E-05 |
| 0.3825   | 2.03E-06       | 4.39E-05 |
| 0.4825   | 2.56E-06       | 5.53E-05 |
| 0.5825   | 3.09E-06       | 6.68E-05 |
| 0.6825   | 3.61E-06       | 7.84E-05 |
| 0.7825   | 4.14E-06       | 8.99E-05 |
| 0.8825   | 4.67E-06       | 1.01E-04 |
| 0.9825   | 5.19E-06       | 1.13E-04 |
| 1.0825   | 9.14E-07       | 1.12E-04 |
| 1.1825   | 7.99E-06       | 1.26E-04 |
| 1.2825   | 1.47E-05       | 1.76E-04 |
| 1.3825   | 2.10E-05       | 2.51E-04 |
| 1.4825   | 2.70E-05       | 3.36E-04 |
| 1.5825   | 3.29E-05       | 4.27E-04 |
| 1.6825   | 3.84E-05       | 5.28E-04 |
| 1.7825   | 4.38E-05       | 6.33E-04 |
| 1.8825   | 4.88E-05       | 7.49E-04 |
| 1.9413   | 5.16E-05       | 8.22E-04 |
| 2        | 5.42E-05       | 8.99E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 2.33E-02    | 3.55E+06 |
| 4.00E-02 | 5.18E-02    | 7.09E+06 |
| 7.00E-02 | 1.07E-01    | 1.24E+07 |
| 0.115    | 2.17E-01    | 2.04E+07 |
| 0.1825   | 4.41E-01    | 3.24E+07 |
| 0.2825   | 7.86E-01    | 5.01E+07 |
| 0.3825   | 0.9188      | 6.79E+07 |
| 0.4825   | 1.0467      | 8.57E+07 |
| 0.5825   | 1.8125      | 1.04E+08 |
| 0.6825   | 2.9931      | 1.21E+08 |
| 0.7825   | 4.7786      | 1.39E+08 |
| 0.8825   | 8.0206      | 1.57E+08 |
| 0.9825   | 12.535      | 1.75E+08 |
| 1.0825   | 367.77      | 1.78E+08 |
| 1.1825   | 379.49      | 1.79E+08 |
| 1.2825   | 381.64      | 1.79E+08 |
| 1.3825   | 374.05      | 1.79E+08 |
| 1.4825   | 366.56      | 1.79E+08 |
| 1.5825   | 358.77      | 1.80E+08 |
| 1.6825   | 349.06      | 1.80E+08 |
| 1.7825   | 340.59      | 1.81E+08 |
| 1.8825   | 328.19      | 1.81E+08 |
| 1.9413   | 325.13      | 1.81E+08 |
| 2        | 320.9       | 1.82E+08 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 2.41E-13     | 2.96E-05 |
| 4.00E-02 | 5.51E-13     | 5.92E-05 |
| 7.00E-02 | 1.18E-12     | 1.04E-04 |
| 0.115    | 2.44E-12     | 1.70E-04 |
| 0.1825   | 5.18E-12     | 2.70E-04 |
| 0.2825   | 1.10E-11     | 4.18E-04 |
| 0.3825   | 2.01E-11     | 5.67E-04 |
| 0.4825   | 3.40E-11     | 7.15E-04 |
| 0.5825   | 5.39E-11     | 8.64E-04 |
| 0.6825   | 8.33E-11     | 1.01E-03 |
| 0.7825   | 1.26E-10     | 1.16E-03 |
| 0.8825   | 1.83E-10     | 1.31E-03 |
| 0.9825   | 3.06E-10     | 1.46E-03 |
| 1.0825   | 3.12E-09     | 1.49E-03 |
| 1.1825   | 3.28E-09     | 1.49E-03 |
| 1.2825   | 3.21E-09     | 1.49E-03 |
| 1.3825   | 3.15E-09     | 1.49E-03 |
| 1.4825   | 3.09E-09     | 1.50E-03 |
| 1.5825   | 3.03E-09     | 1.50E-03 |
| 1.6825   | 2.95E-09     | 1.50E-03 |
| 1.7825   | 2.89E-09     | 1.51E-03 |
| 1.8825   | 2.79E-09     | 1.51E-03 |
| 1.9413   | 2.78E-09     | 1.51E-03 |
| 2        | 2.74E-09     | 1.51E-03 |

600°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 2.06E-07       | 4.43E-06 |
| 4.00E-02 | 4.12E-07       | 8.86E-06 |
| 7.00E-02 | 7.20E-07       | 1.55E-05 |
| 0.115    | 1.18E-06       | 2.55E-05 |
| 0.1825   | 1.87E-06       | 4.05E-05 |
| 0.2825   | 2.90E-06       | 6.27E-05 |
| 0.3825   | 3.92E-06       | 8.50E-05 |
| 0.4825   | 4.94E-06       | 1.07E-04 |
| 0.5825   | 5.96E-06       | 1.30E-04 |
| 0.6825   | 6.96E-06       | 1.52E-04 |
| 0.7825   | 7.90E-06       | 1.74E-04 |
| 0.8175   | 8.09E-06       | 4.35E-04 |
| 0.8525   | 8.82E-06       | 1.16E-03 |
|          |                |          |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 2.59E-02    | 3.55E+06 |
| 4.00E-02 | 6.36E-02    | 7.09E+06 |
| 7.00E-02 | 1.42E-01    | 1.24E+07 |
| 0.115    | 2.92E-01    | 2.04E+07 |
| 0.1825   | 4.79E-01    | 3.24E+07 |
| 0.2825   | 6.43E-01    | 5.02E+07 |
| 0.3825   | 1.4094      | 6.80E+07 |
| 0.4825   | 3.5581      | 8.60E+07 |
| 0.5825   | 9.4138      | 1.04E+08 |
| 0.6825   | 27.986      | 1.23E+08 |
| 0.7825   | 108.49      | 1.45E+08 |
| 0.8175   | 451.77      | 1.48E+08 |
| 0.8525   | 1585.8      | 1.59E+08 |
|          |             |          |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 5.30E-13     | 5.73E-05 |
| 4.00E-02 | 1.36E-12     | 1.15E-04 |
| 7.00E-02 | 3.14E-12     | 2.01E-04 |
| 0.115    | 7.25E-12     | 3.30E-04 |
| 0.1825   | 1.66E-11     | 5.23E-04 |
| 0.2825   | 4.13E-11     | 8.11E-04 |
| 0.3825   | 8.67E-11     | 1.10E-03 |
| 0.4825   | 1.64E-10     | 1.39E-03 |
| 0.5825   | 4.58E-10     | 1.68E-03 |
| 0.6825   | 1.43E-09     | 1.99E-03 |
| 0.7825   | 4.61E-09     | 2.34E-03 |
| 0.8175   | 1.49E-08     | 2.39E-03 |
| 0.8525   | 3.33E-08     | 2.57E-03 |
|          |              |          |

700°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 4.91E-07       | 1.06E-05 |
| 4.00E-02 | 9.81E-07       | 2.11E-05 |
| 7.00E-02 | 1.71E-06       | 3.70E-05 |
| 0.115    | 2.81E-06       | 6.09E-05 |
| 0.1825   | 4.46E-06       | 9.68E-05 |
| 0.2825   | 6.88E-06       | 1.50E-04 |
| 0.3825   | 9.20E-06       | 3.44E-04 |
| 0.38875  | 9.12E-06       | 2.98E-04 |
| 0.39187  | 8.89E-06       | 2.77E-04 |
|          |                |          |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 3.41E-02    | 3.55E+06 |
| 4.00E-02 | 9.28E-02    | 7.10E+06 |
| 7.00E-02 | 1.97E-01    | 1.24E+07 |
| 0.115    | 2.50E-01    | 2.04E+07 |
| 0.1825   | 8.61E-01    | 3.25E+07 |
| 0.2825   | 4.61E+00    | 5.09E+07 |
| 0.3825   | 47.789      | 7.16E+07 |
| 0.38875  | 163.93      | 7.23E+07 |
| 0.39187  | 484.36      | 7.27E+07 |
|          |             |          |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.74E-12     | 1.37E-04 |
| 4.00E-02 | 5.11E-12     | 2.73E-04 |
| 7.00E-02 | 1.36E-11     | 4.79E-04 |
| 0.115    | 3.74E-11     | 7.87E-04 |
| 0.1825   | 1.09E-10     | 1.25E-03 |
| 0.2825   | 5.50E-10     | 1.96E-03 |
| 0.3825   | 5.31E-09     | 2.76E-03 |
| 0.38875  | 1.47E-08     | 2.78E-03 |
| 0.39187  | 3.63E-08     | 2.80E-03 |
|          |              |          |

*Control Model Results (Same model as above but without connection force):*

Room  
Temperature  
(RT)

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 3.16E-17       | 1.38E-15 |
| 4.00E-02 | 2.09E-17       | 4.47E-15 |
| 7.00E-02 | 6.44E-17       | 2.82E-15 |
| 0.115    | 6.77E-17       | 3.12E-15 |
| 0.1825   | 4.29E-17       | 2.89E-15 |
| 0.2825   | 7.44E-17       | 2.21E-15 |
| 0.3825   | 5.85E-17       | 2.58E-15 |
| 0.4825   | 2.29E-16       | 4.76E-15 |
| 0.5825   | 1.17E-16       | 5.00E-15 |
| 0.6825   | 9.44E-17       | 5.29E-15 |
| 0.7825   | 1.35E-16       | 6.45E-15 |
| 0.8825   | 6.06E-18       | 6.53E-15 |
| 0.9825   | 3.23E-17       | 7.18E-15 |
| 1.0825   | 3.68E-06       | 2.64E-05 |
| 1.1825   | 8.13E-06       | 5.89E-05 |
| 1.2825   | 1.26E-05       | 9.18E-05 |
| 1.3825   | 1.70E-05       | 1.25E-04 |
| 1.4825   | 2.15E-05       | 1.59E-04 |
| 1.5825   | 2.60E-05       | 1.93E-04 |
| 1.6825   | 3.05E-05       | 2.28E-04 |
| 1.7825   | 3.49E-05       | 2.64E-04 |
| 1.8825   | 3.94E-05       | 2.99E-04 |
| 1.9413   | 4.21E-05       | 3.21E-04 |
| 2        | 4.47E-05       | 3.42E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 2.68E-06    | 9.79E-03 |
| 4.00E-02 | 8.48E-06    | 1.61E-02 |
| 7.00E-02 | 3.47E-06    | 1.93E-02 |
| 0.115    | 4.22E-06    | 2.02E-02 |
| 0.1825   | 1.00E-05    | 2.07E-02 |
| 0.2825   | 1.23E-05    | 2.29E-02 |
| 0.3825   | 6.58E-06    | 2.90E-02 |
| 0.4825   | 9.90E-06    | 3.39E-02 |
| 0.5825   | 1.45E-05    | 3.00E-02 |
| 0.6825   | 1.05E-05    | 3.38E-02 |
| 0.7825   | 7.49E-06    | 3.69E-02 |
| 0.8825   | 6.33E-06    | 3.99E-02 |
| 0.9825   | 1.05E-05    | 4.27E-02 |
| 1.0825   | 6.62E-02    | 2.97E+06 |
| 1.1825   | 1.40E-01    | 6.62E+06 |
| 1.2825   | 2.48E-01    | 1.03E+07 |
| 1.3825   | 3.57E-01    | 1.41E+07 |
| 1.4825   | 4.70E-01    | 1.79E+07 |
| 1.5825   | 5.83E-01    | 2.18E+07 |
| 1.6825   | 6.97E-01    | 2.57E+07 |
| 1.7825   | 8.14E-01    | 2.97E+07 |
| 1.8825   | 9.31E-01    | 3.37E+07 |
| 1.9413   | 9.71E-01    | 3.61E+07 |
| 2        | 1.01E+00    | 3.85E+07 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.22E-16     | 5.70E-14 |
| 4.00E-02 | 1.24E-16     | 8.30E-14 |
| 7.00E-02 | 2.54E-16     | 1.39E-13 |
| 0.115    | 2.00E-16     | 1.72E-13 |
| 0.1825   | 3.18E-16     | 1.77E-13 |
| 0.2825   | 2.75E-16     | 1.89E-13 |
| 0.3825   | 3.93E-16     | 2.20E-13 |
| 0.4825   | 5.04E-16     | 2.30E-13 |
| 0.5825   | 3.61E-16     | 2.82E-13 |
| 0.6825   | 5.97E-16     | 3.23E-13 |
| 0.7825   | 3.74E-16     | 3.36E-13 |
| 0.8825   | 5.94E-16     | 3.28E-13 |
| 0.9825   | 7.64E-16     | 3.25E-13 |
| 1.0825   | 3.59E-13     | 1.57E-05 |
| 1.1825   | 7.23E-13     | 3.51E-05 |
| 1.2825   | 1.27E-12     | 5.46E-05 |
| 1.3825   | 1.81E-12     | 7.45E-05 |
| 1.4825   | 2.38E-12     | 9.47E-05 |
| 1.5825   | 2.95E-12     | 1.15E-04 |
| 1.6825   | 3.52E-12     | 1.36E-04 |
| 1.7825   | 4.12E-12     | 1.57E-04 |
| 1.8825   | 4.71E-12     | 1.78E-04 |
| 1.9413   | 4.91E-12     | 1.91E-04 |
| 2        | 5.12E-12     | 2.04E-04 |

300°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 3.16E-17       | 1.38E-15 |
| 4.00E-02 | 2.09E-17       | 4.47E-15 |
| 7.00E-02 | 6.44E-17       | 2.82E-15 |
| 0.115    | 6.77E-17       | 3.12E-15 |
| 0.1825   | 4.29E-17       | 2.89E-15 |
| 0.2825   | 7.44E-17       | 2.21E-15 |
| 0.3825   | 5.85E-17       | 2.58E-15 |
| 0.4825   | 2.29E-16       | 4.76E-15 |
| 0.5825   | 1.17E-16       | 5.00E-15 |
| 0.6825   | 9.44E-17       | 5.29E-15 |
| 0.7825   | 1.35E-16       | 6.45E-15 |
| 0.8825   | 2.50E-18       | 6.50E-15 |
| 0.9825   | 1.63E-17       | 8.24E-15 |
| 1.0825   | 4.59E-06       | 3.31E-05 |
| 1.1825   | 1.02E-05       | 7.38E-05 |
| 1.2825   | 1.57E-05       | 1.15E-04 |
| 1.3825   | 2.13E-05       | 1.57E-04 |
| 1.4825   | 2.69E-05       | 2.00E-04 |
| 1.5825   | 3.25E-05       | 2.44E-04 |
| 1.6825   | 3.81E-05       | 2.89E-04 |
| 1.7825   | 4.37E-05       | 3.34E-04 |
| 1.8825   | 4.94E-05       | 3.80E-04 |
| 1.9413   | 5.27E-05       | 4.08E-04 |
| 2        | 5.60E-05       | 4.36E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 2.14E-06    | 7.83E-03 |
| 4.00E-02 | 6.78E-06    | 1.29E-02 |
| 7.00E-02 | 2.77E-06    | 1.55E-02 |
| 0.115    | 3.37E-06    | 1.61E-02 |
| 0.1825   | 8.00E-06    | 1.65E-02 |
| 0.2825   | 9.86E-06    | 1.83E-02 |
| 0.3825   | 5.26E-06    | 2.32E-02 |
| 0.4825   | 7.92E-06    | 2.71E-02 |
| 0.5825   | 1.16E-05    | 2.40E-02 |
| 0.6825   | 8.41E-06    | 2.71E-02 |
| 0.7825   | 5.99E-06    | 2.95E-02 |
| 0.8825   | 1.12E-05    | 3.19E-02 |
| 0.9825   | 9.05E-06    | 3.32E-02 |
| 1.0825   | 8.36E-02    | 2.98E+06 |
| 1.1825   | 1.77E-01    | 6.65E+06 |
| 1.2825   | 3.11E-01    | 1.04E+07 |
| 1.3825   | 4.49E-01    | 1.42E+07 |
| 1.4825   | 5.92E-01    | 1.81E+07 |
| 1.5825   | 7.37E-01    | 2.20E+07 |
| 1.6825   | 8.88E-01    | 2.60E+07 |
| 1.7825   | 1.04E+00    | 3.01E+07 |
| 1.8825   | 1.19E+00    | 3.43E+07 |
| 1.9413   | 1.24E+00    | 3.68E+07 |
| 2        | 1.30E+00    | 3.93E+07 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.22E-16     | 5.70E-14 |
| 4.00E-02 | 1.24E-16     | 8.30E-14 |
| 7.00E-02 | 2.54E-16     | 1.39E-13 |
| 0.115    | 2.00E-16     | 1.72E-13 |
| 0.1825   | 3.18E-16     | 1.77E-13 |
| 0.2825   | 2.75E-16     | 1.89E-13 |
| 0.3825   | 3.93E-16     | 2.20E-13 |
| 0.4825   | 5.04E-16     | 2.30E-13 |
| 0.5825   | 3.61E-16     | 2.82E-13 |
| 0.6825   | 5.97E-16     | 3.23E-13 |
| 0.7825   | 3.74E-16     | 3.36E-13 |
| 0.8825   | 5.78E-16     | 3.28E-13 |
| 0.9825   | 6.28E-16     | 3.50E-13 |
| 1.0825   | 5.45E-13     | 1.97E-05 |
| 1.1825   | 1.13E-12     | 4.40E-05 |
| 1.2825   | 1.97E-12     | 6.86E-05 |
| 1.3825   | 2.85E-12     | 9.38E-05 |
| 1.4825   | 3.75E-12     | 1.19E-04 |
| 1.5825   | 4.66E-12     | 1.45E-04 |
| 1.6825   | 5.62E-12     | 1.72E-04 |
| 1.7825   | 6.56E-12     | 1.99E-04 |
| 1.8825   | 7.53E-12     | 2.27E-04 |
| 1.9413   | 7.86E-12     | 2.43E-04 |
| 2        | 8.22E-12     | 2.60E-04 |



400°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 3.16E-17       | 1.38E-15 |
| 4.00E-02 | 2.09E-17       | 4.47E-15 |
| 7.00E-02 | 6.44E-17       | 2.82E-15 |
| 0.115    | 6.77E-17       | 3.12E-15 |
| 0.1825   | 4.29E-17       | 2.89E-15 |
| 0.2825   | 7.44E-17       | 2.21E-15 |
| 0.3825   | 5.85E-17       | 2.58E-15 |
| 0.4825   | 2.29E-16       | 4.76E-15 |
| 0.5825   | 1.17E-16       | 5.00E-15 |
| 0.6825   | 9.44E-17       | 5.29E-15 |
| 0.7825   | 1.35E-16       | 6.45E-15 |
| 0.8825   | 6.06E-18       | 6.53E-15 |
| 0.9825   | 3.23E-17       | 7.18E-15 |
| 1.0825   | 5.25E-06       | 3.78E-05 |
| 1.1825   | 1.16E-05       | 8.46E-05 |
| 1.2825   | 1.80E-05       | 1.32E-04 |
| 1.3825   | 2.44E-05       | 1.81E-04 |
| 1.4825   | 3.08E-05       | 2.31E-04 |
| 1.5825   | 3.72E-05       | 2.81E-04 |
| 1.6825   | 4.36E-05       | 3.33E-04 |
| 1.7825   | 5.00E-05       | 3.86E-04 |
| 1.8825   | 5.65E-05       | 4.40E-04 |
| 1.9413   | 6.03E-05       | 4.72E-04 |
| 2        | 6.42E-05       | 5.05E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 1.87E-06    | 6.86E-03 |
| 4.00E-02 | 5.93E-06    | 1.13E-02 |
| 7.00E-02 | 2.43E-06    | 1.35E-02 |
| 0.115    | 2.95E-06    | 1.41E-02 |
| 0.1825   | 7.00E-06    | 1.45E-02 |
| 0.2825   | 8.63E-06    | 1.60E-02 |
| 0.3825   | 4.60E-06    | 2.03E-02 |
| 0.4825   | 6.93E-06    | 2.37E-02 |
| 0.5825   | 1.02E-05    | 2.10E-02 |
| 0.6825   | 7.36E-06    | 2.37E-02 |
| 0.7825   | 5.24E-06    | 2.58E-02 |
| 0.8825   | 4.43E-06    | 2.79E-02 |
| 0.9825   | 7.36E-06    | 2.99E-02 |
| 1.0825   | 9.81E-02    | 2.98E+06 |
| 1.1825   | 2.06E-01    | 6.66E+06 |
| 1.2825   | 3.59E-01    | 1.04E+07 |
| 1.3825   | 5.18E-01    | 1.43E+07 |
| 1.4825   | 6.83E-01    | 1.82E+07 |
| 1.5825   | 8.54E-01    | 2.22E+07 |
| 1.6825   | 1.03E+00    | 2.63E+07 |
| 1.7825   | 1.20E+00    | 3.04E+07 |
| 1.8825   | 1.39E+00    | 3.47E+07 |
| 1.9413   | 1.45E+00    | 3.73E+07 |
| 2        | 1.51E+00    | 3.98E+07 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.22E-16     | 5.70E-14 |
| 4.00E-02 | 1.24E-16     | 8.30E-14 |
| 7.00E-02 | 2.54E-16     | 1.39E-13 |
| 0.115    | 2.00E-16     | 1.72E-13 |
| 0.1825   | 3.18E-16     | 1.77E-13 |
| 0.2825   | 2.75E-16     | 1.89E-13 |
| 0.3825   | 3.93E-16     | 2.20E-13 |
| 0.4825   | 5.04E-16     | 2.30E-13 |
| 0.5825   | 3.61E-16     | 2.82E-13 |
| 0.6825   | 5.97E-16     | 3.23E-13 |
| 0.7825   | 3.74E-16     | 3.36E-13 |
| 0.8825   | 5.94E-16     | 3.28E-13 |
| 0.9825   | 7.64E-16     | 3.25E-13 |
| 1.0825   | 7.22E-13     | 2.25E-05 |
| 1.1825   | 1.50E-12     | 5.03E-05 |
| 1.2825   | 2.60E-12     | 7.87E-05 |
| 1.3825   | 3.75E-12     | 1.08E-04 |
| 1.4825   | 4.94E-12     | 1.37E-04 |
| 1.5825   | 6.17E-12     | 1.67E-04 |
| 1.6825   | 7.41E-12     | 1.98E-04 |
| 1.7825   | 8.71E-12     | 2.30E-04 |
| 1.8825   | 1.00E-11     | 2.62E-04 |
| 1.9413   | 1.05E-11     | 2.81E-04 |
| 2        | 1.09E-11     | 3.01E-04 |

500°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 3.16E-17       | 1.38E-15 |
| 4.00E-02 | 2.09E-17       | 4.47E-15 |
| 7.00E-02 | 6.44E-17       | 2.82E-15 |
| 0.115    | 6.77E-17       | 3.12E-15 |
| 0.1825   | 4.29E-17       | 2.89E-15 |
| 0.2825   | 7.44E-17       | 2.21E-15 |
| 0.3825   | 5.85E-17       | 2.58E-15 |
| 0.4825   | 2.29E-16       | 4.76E-15 |
| 0.5825   | 1.17E-16       | 5.00E-15 |
| 0.6825   | 9.44E-17       | 5.29E-15 |
| 0.7825   | 1.35E-16       | 6.45E-15 |
| 0.8825   | 6.06E-18       | 6.53E-15 |
| 0.9825   | 3.23E-17       | 7.18E-15 |
| 1.0825   | 6.13E-06       | 4.42E-05 |
| 1.1825   | 1.36E-05       | 9.90E-05 |
| 1.2825   | 2.10E-05       | 1.55E-04 |
| 1.3825   | 2.84E-05       | 2.12E-04 |
| 1.4825   | 3.59E-05       | 2.71E-04 |
| 1.5825   | 4.34E-05       | 3.32E-04 |
| 1.6825   | 5.09E-05       | 3.93E-04 |
| 1.7825   | 5.85E-05       | 4.57E-04 |
| 1.8825   | 6.61E-05       | 5.22E-04 |
| 1.9413   | 7.06E-05       | 5.61E-04 |
| 2        | 7.50E-05       | 6.01E-04 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 1.61E-06    | 5.88E-03 |
| 4.00E-02 | 5.09E-06    | 9.68E-03 |
| 7.00E-02 | 2.08E-06    | 1.16E-02 |
| 0.115    | 2.53E-06    | 1.21E-02 |
| 0.1825   | 6.00E-06    | 1.24E-02 |
| 0.2825   | 7.39E-06    | 1.37E-02 |
| 0.3825   | 3.95E-06    | 1.74E-02 |
| 0.4825   | 5.94E-06    | 2.03E-02 |
| 0.5825   | 8.71E-06    | 1.80E-02 |
| 0.6825   | 6.31E-06    | 2.03E-02 |
| 0.7825   | 4.49E-06    | 2.21E-02 |
| 0.8825   | 3.80E-06    | 2.39E-02 |
| 0.9825   | 6.31E-06    | 2.56E-02 |
| 1.0825   | 1.14E-01    | 2.99E+06 |
| 1.1825   | 2.40E-01    | 6.68E+06 |
| 1.2825   | 4.21E-01    | 1.05E+07 |
| 1.3825   | 6.11E-01    | 1.43E+07 |
| 1.4825   | 8.06E-01    | 1.83E+07 |
| 1.5825   | 1.01E+00    | 2.24E+07 |
| 1.6825   | 1.21E+00    | 2.66E+07 |
| 1.7825   | 1.43E+00    | 3.09E+07 |
| 1.8825   | 1.65E+00    | 3.53E+07 |
| 1.9413   | 1.72E+00    | 3.79E+07 |
| 2        | 1.80E+00    | 4.06E+07 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.22E-16     | 5.70E-14 |
| 4.00E-02 | 1.24E-16     | 8.30E-14 |
| 7.00E-02 | 2.54E-16     | 1.39E-13 |
| 0.115    | 2.00E-16     | 1.72E-13 |
| 0.1825   | 3.18E-16     | 1.77E-13 |
| 0.2825   | 2.75E-16     | 1.89E-13 |
| 0.3825   | 3.93E-16     | 2.20E-13 |
| 0.4825   | 5.04E-16     | 2.30E-13 |
| 0.5825   | 3.61E-16     | 2.82E-13 |
| 0.6825   | 5.97E-16     | 3.23E-13 |
| 0.7825   | 3.74E-16     | 3.36E-13 |
| 0.8825   | 5.94E-16     | 3.28E-13 |
| 0.9825   | 7.64E-16     | 3.25E-13 |
| 1.0825   | 9.75E-13     | 2.63E-05 |
| 1.1825   | 2.03E-12     | 5.89E-05 |
| 1.2825   | 3.55E-12     | 9.23E-05 |
| 1.3825   | 5.15E-12     | 1.26E-04 |
| 1.4825   | 6.79E-12     | 1.62E-04 |
| 1.5825   | 8.48E-12     | 1.97E-04 |
| 1.6825   | 1.02E-11     | 2.34E-04 |
| 1.7825   | 1.20E-11     | 2.72E-04 |
| 1.8825   | 1.39E-11     | 3.11E-04 |
| 1.9413   | 1.45E-11     | 3.34E-04 |
| 2        | 1.52E-11     | 3.58E-04 |

600°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 3.16E-17       | 1.38E-15 |
| 4.00E-02 | 2.09E-17       | 4.47E-15 |
| 7.00E-02 | 6.44E-17       | 2.82E-15 |
| 0.115    | 6.77E-17       | 3.12E-15 |
| 0.1825   | 4.29E-17       | 2.89E-15 |
| 0.2825   | 7.44E-17       | 2.21E-15 |
| 0.3825   | 5.85E-17       | 2.58E-15 |
| 0.4825   | 2.29E-16       | 4.76E-15 |
| 0.5825   | 1.17E-16       | 5.00E-15 |
| 0.6825   | 9.44E-17       | 5.29E-15 |
| 0.7825   | 1.35E-16       | 6.45E-15 |
| 0.8825   | 6.06E-18       | 6.53E-15 |
| 0.9825   | 3.23E-17       | 7.18E-15 |
| 1.0825   | 1.19E-05       | 8.63E-05 |
| 1.1825   | 2.63E-05       | 1.95E-04 |
| 1.2825   | 4.07E-05       | 3.10E-04 |
| 1.3825   | 5.53E-05       | 4.30E-04 |
| 1.4825   | 7.01E-05       | 5.56E-04 |
| 1.5825   | 8.44E-05       | 6.89E-04 |
| 1.6825   | 9.87E-05       | 8.30E-04 |
| 1.7825   | 1.13E-04       | 9.83E-04 |
| 1.8825   | 1.27E-04       | 1.15E-03 |
| 1.9413   | 1.36E-04       | 1.25E-03 |
| 2        | 1.44E-04       | 1.35E-03 |

| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 8.30E-07    | 3.04E-03 |
| 4.00E-02 | 2.63E-06    | 5.00E-03 |
| 7.00E-02 | 1.07E-06    | 5.99E-03 |
| 0.115    | 1.31E-06    | 6.25E-03 |
| 0.1825   | 3.10E-06    | 6.40E-03 |
| 0.2825   | 3.82E-06    | 7.10E-03 |
| 0.3825   | 2.04E-06    | 8.99E-03 |
| 0.4825   | 3.07E-06    | 1.05E-02 |
| 0.5825   | 4.50E-06    | 9.30E-03 |
| 0.6825   | 3.26E-06    | 1.05E-02 |
| 0.7825   | 2.32E-06    | 1.14E-02 |
| 0.8825   | 1.96E-06    | 1.24E-02 |
| 0.9825   | 3.26E-06    | 1.32E-02 |
| 1.0825   | 2.27E-01    | 3.01E+06 |
| 1.1825   | 4.74E-01    | 6.82E+06 |
| 1.2825   | 8.28E-01    | 1.08E+07 |
| 1.3825   | 1.20E+00    | 1.50E+07 |
| 1.4825   | 1.59E+00    | 1.94E+07 |
| 1.5825   | 2.00E+00    | 2.41E+07 |
| 1.6825   | 2.44E+00    | 2.90E+07 |
| 1.7825   | 2.90E+00    | 3.42E+07 |
| 1.8825   | 3.40E+00    | 3.97E+07 |
| 1.9413   | 3.65E+00    | 4.31E+07 |
| 2        | 3.86E+00    | 4.67E+07 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.22E-16     | 5.70E-14 |
| 4.00E-02 | 1.24E-16     | 8.30E-14 |
| 7.00E-02 | 2.54E-16     | 1.39E-13 |
| 0.115    | 2.00E-16     | 1.72E-13 |
| 0.1825   | 3.18E-16     | 1.77E-13 |
| 0.2825   | 2.75E-16     | 1.89E-13 |
| 0.3825   | 3.93E-16     | 2.20E-13 |
| 0.4825   | 5.04E-16     | 2.30E-13 |
| 0.5825   | 3.61E-16     | 2.82E-13 |
| 0.6825   | 5.97E-16     | 3.23E-13 |
| 0.7825   | 3.74E-16     | 3.36E-13 |
| 0.8825   | 5.94E-16     | 3.28E-13 |
| 0.9825   | 7.64E-16     | 3.25E-13 |
| 1.0825   | 3.70E-12     | 5.14E-05 |
| 1.1825   | 7.73E-12     | 1.16E-04 |
| 1.2825   | 1.35E-11     | 1.84E-04 |
| 1.3825   | 1.95E-11     | 2.56E-04 |
| 1.4825   | 2.59E-11     | 3.31E-04 |
| 1.5825   | 3.26E-11     | 4.11E-04 |
| 1.6825   | 3.97E-11     | 4.95E-04 |
| 1.7825   | 4.73E-11     | 5.83E-04 |
| 1.8825   | 5.54E-11     | 6.77E-04 |
| 1.9413   | 5.95E-11     | 7.35E-04 |
| 2        | 6.30E-11     | 7.95E-04 |

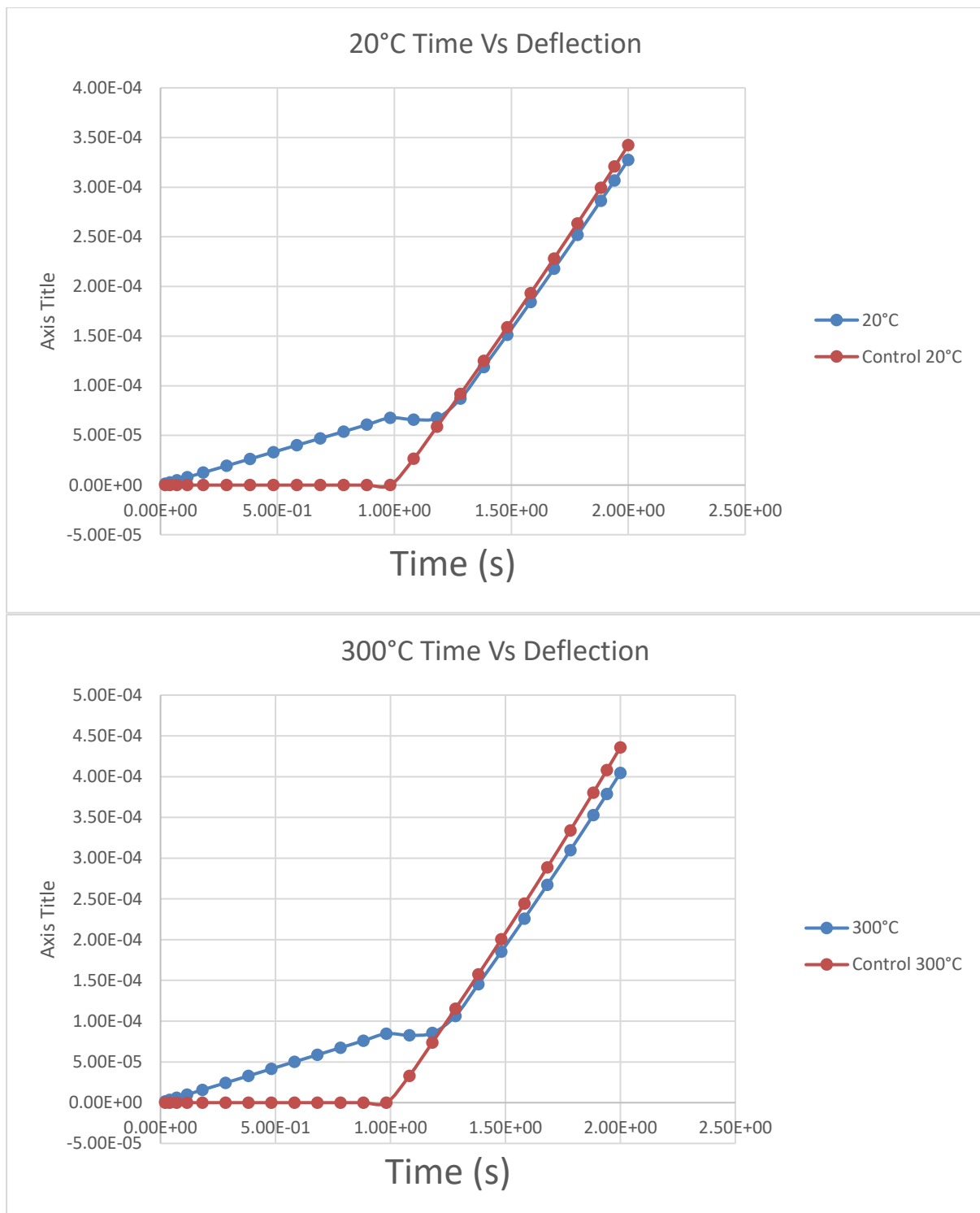
700°C

| Time (s) | Deflection (m) |          |
|----------|----------------|----------|
|          | Min            | Max      |
| 2.00E-02 | 3.16E-17       | 1.38E-15 |
| 4.00E-02 | 2.09E-17       | 4.47E-15 |
| 7.00E-02 | 6.44E-17       | 2.82E-15 |
| 0.115    | 6.77E-17       | 3.12E-15 |
| 0.1825   | 4.29E-17       | 2.89E-15 |
| 0.2825   | 7.44E-17       | 2.21E-15 |
| 0.3825   | 5.85E-17       | 2.58E-15 |
| 0.4825   | 2.29E-16       | 4.76E-15 |
| 0.5825   | 1.17E-16       | 5.00E-15 |
| 0.6825   | 9.44E-17       | 5.29E-15 |
| 0.7825   | 1.35E-16       | 6.45E-15 |
| 0.8825   | 6.06E-18       | 6.53E-15 |
| 0.9825   | 3.59E-17       | 7.19E-15 |
| 1.0825   | 2.83E-05       | 2.11E-04 |
| 1.1825   | 6.30E-05       | 4.96E-04 |
| 1.2825   | 9.75E-05       | 8.17E-04 |
| 1.3825   | 1.31E-04       | 1.20E-03 |
| 1.4825   | 1.66E-04       | 1.64E-03 |
| 1.5825   | 2.01E-04       | 2.16E-03 |
| 1.6825   | 2.34E-04       | 2.77E-03 |
| 1.7825   | 2.68E-04       | 3.48E-03 |
| 1.8825   | 2.98E-04       | 4.29E-03 |
| 1.9413   | 3.14E-04       | 4.80E-03 |
| 2        | 3.30E-04       | 5.38E-03 |

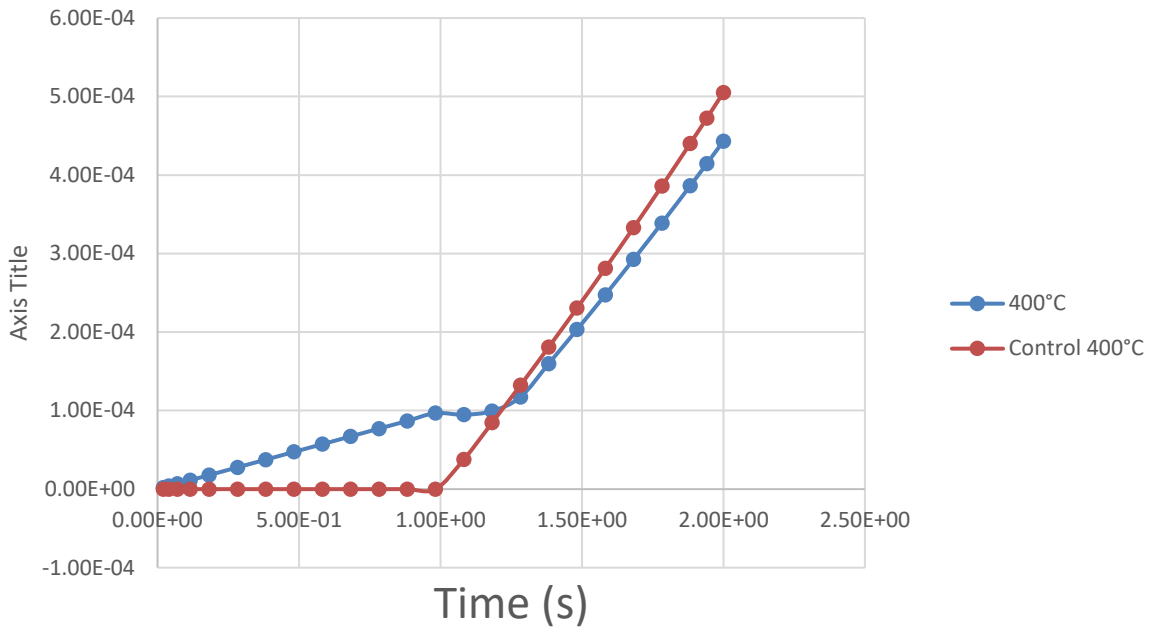
| Time (s) | Stress (Pa) |          |
|----------|-------------|----------|
|          | Min         | Max      |
| 2.00E-02 | 3.48E-07    | 1.27E-03 |
| 4.00E-02 | 1.10E-06    | 2.10E-03 |
| 7.00E-02 | 4.51E-07    | 2.51E-03 |
| 0.115    | 5.48E-07    | 2.62E-03 |
| 0.1825   | 1.30E-06    | 2.69E-03 |
| 0.2825   | 1.60E-06    | 2.98E-03 |
| 0.3825   | 8.55E-07    | 3.77E-03 |
| 0.4825   | 1.29E-06    | 4.41E-03 |
| 0.5825   | 1.89E-06    | 3.90E-03 |
| 0.6825   | 1.37E-06    | 4.40E-03 |
| 0.7825   | 9.73E-07    | 4.80E-03 |
| 0.8825   | 8.23E-07    | 5.19E-03 |
| 0.9825   | 1.47E-06    | 5.54E-03 |
| 1.0825   | 5.72E-01    | 3.09E+06 |
| 1.1825   | 1.19E+00    | 7.26E+06 |
| 1.2825   | 2.13E+00    | 1.20E+07 |
| 1.3825   | 3.21E+00    | 1.74E+07 |
| 1.4825   | 4.47E+00    | 2.37E+07 |
| 1.5825   | 6.02E+00    | 3.13E+07 |
| 1.6825   | 8.01E+00    | 4.06E+07 |
| 1.7825   | 1.07E+01    | 5.17E+07 |
| 1.8825   | 1.43E+01    | 6.49E+07 |
| 1.9413   | 1.65E+01    | 6.99E+07 |
| 2        | 1.67E+01    | 6.94E+07 |

| Time (s) | Strain (m/m) |          |
|----------|--------------|----------|
|          | Min          | Max      |
| 2.00E-02 | 1.22E-16     | 5.70E-14 |
| 4.00E-02 | 1.24E-16     | 8.30E-14 |
| 7.00E-02 | 2.54E-16     | 1.39E-13 |
| 0.115    | 2.00E-16     | 1.72E-13 |
| 0.1825   | 3.18E-16     | 1.77E-13 |
| 0.2825   | 2.75E-16     | 1.89E-13 |
| 0.3825   | 3.93E-16     | 2.20E-13 |
| 0.4825   | 5.04E-16     | 2.30E-13 |
| 0.5825   | 3.61E-16     | 2.82E-13 |
| 0.6825   | 5.97E-16     | 3.23E-13 |
| 0.7825   | 3.74E-16     | 3.36E-13 |
| 0.8825   | 5.94E-16     | 3.28E-13 |
| 0.9825   | 5.73E-16     | 3.25E-13 |
| 1.0825   | 2.24E-11     | 1.26E-04 |
| 1.1825   | 4.63E-11     | 2.95E-04 |
| 1.2825   | 8.28E-11     | 4.87E-04 |
| 1.3825   | 1.25E-10     | 7.06E-04 |
| 1.4825   | 1.74E-10     | 9.66E-04 |
| 1.5825   | 2.34E-10     | 1.28E-03 |
| 1.6825   | 3.12E-10     | 1.65E-03 |
| 1.7825   | 4.19E-10     | 2.11E-03 |
| 1.8825   | 5.73E-10     | 2.65E-03 |
| 1.9413   | 6.88E-10     | 2.84E-03 |
| 2        | 6.50E-10     | 2.86E-03 |

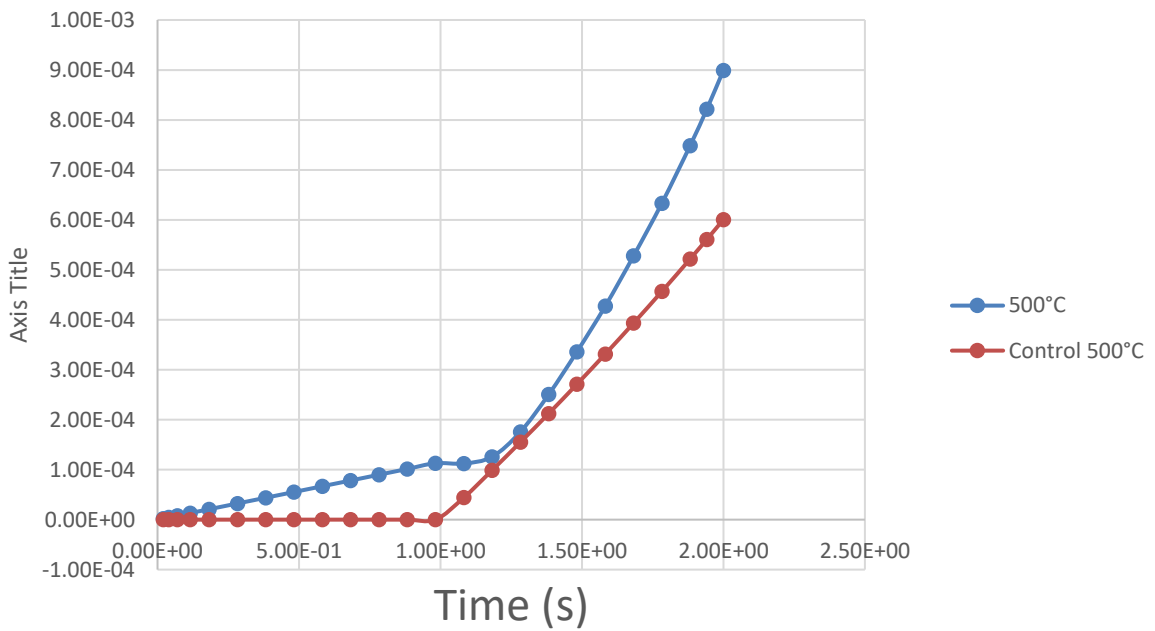
Graphical Representation of time Vs displacement at regular temperature intervals:

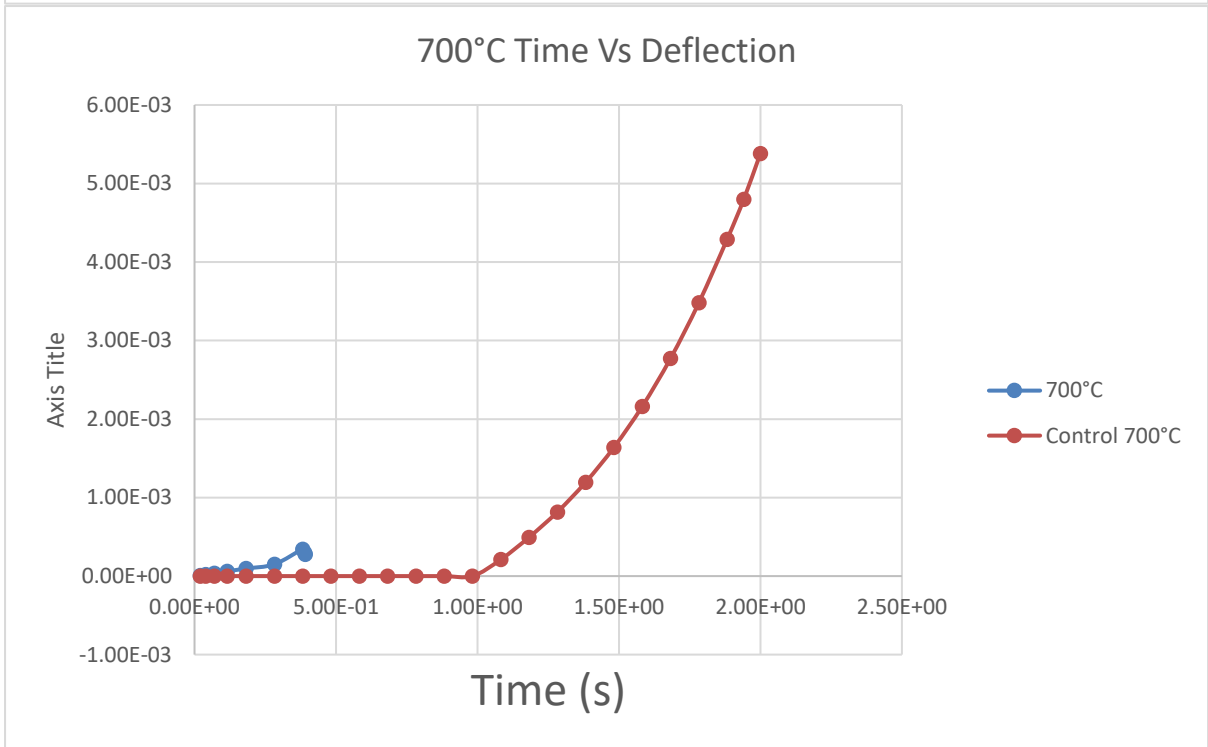
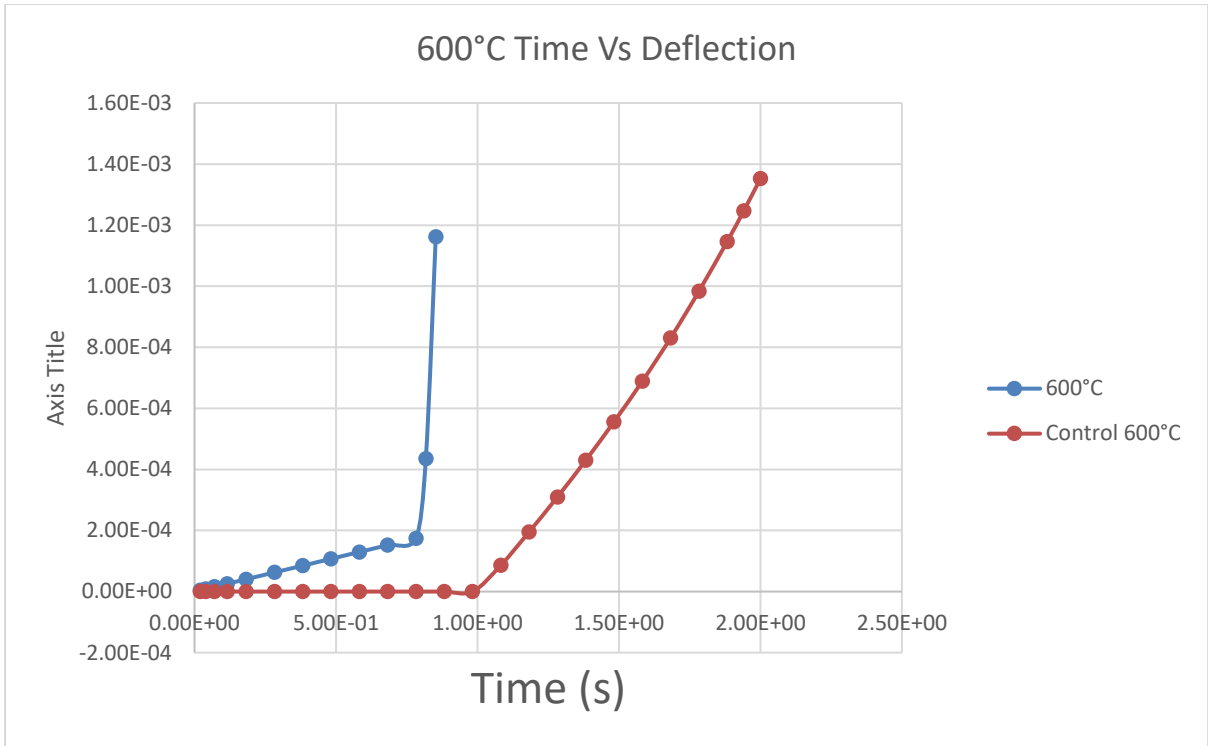


400°C Time Vs Deflection



500°C Time Vs Deflection





## Appendix 2

Engineering Data (For elevated temperatures):

| Engineering Data: (S355 Steel) |  |                |
|--------------------------------|--|----------------|
| Steel Temperature              | Reduction factors relative to room temperature.<br>From Table 3.1 in BS EN 1993-1-2:2005 |                |
|                                | Yeild Strength   | Youngs Modulus |
| 20°C                           | 1.000  | 1.000          |
| 100°C                          | 1.000  | 1.000          |
| 200°C                          | 1.000  | 0.900          |
| 300°C                          | 1.000  | 0.800          |
| 400°C                          | 1.000  | 0.700          |
| 500°C                          | 0.780  | 0.600          |
| 600°C                          | 0.470  | 0.310          |
| 700°C                          | 0.230  | 0.130          |
| 800°C                          | 0.110  | 0.090          |

| Adjusted values due to increase in temperature relative to room temperature |                      |   |
|---|----------------------|---|
| Yeild Strength (Mpa)  | Youngs Modulus (MPa) | Tangent Modulus (MPa) (Assumed to be 1% of Young's Modulus) |
| 355   | 200000               | 200   |
| 355   | 200000               | 200   |
| 355   | 180000               | 180   |
| 355   | 160000               | 160   |
| 355   | 140000               | 140   |
| 276.9   | 120000               | 120   |
| 166.85  | 62000                | 62  |
| 81.65   | 26000                | 26  |
| 39.05   | 18000                | 18  |