

An Algorithm for the UK Graphical Method facilitating automated assessment of intumescent coatings

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How does the UK Graphical Method work?

- Based upon a scatter plot
 - Inverse Section Factor against Performance Time
- Curves are drawn based upon best fit of data points with the same DFT
- At least three points are believed necessary for each curve
- One point may be a baseline point of 10 minutes performance



How does the UK Graphical Method work?

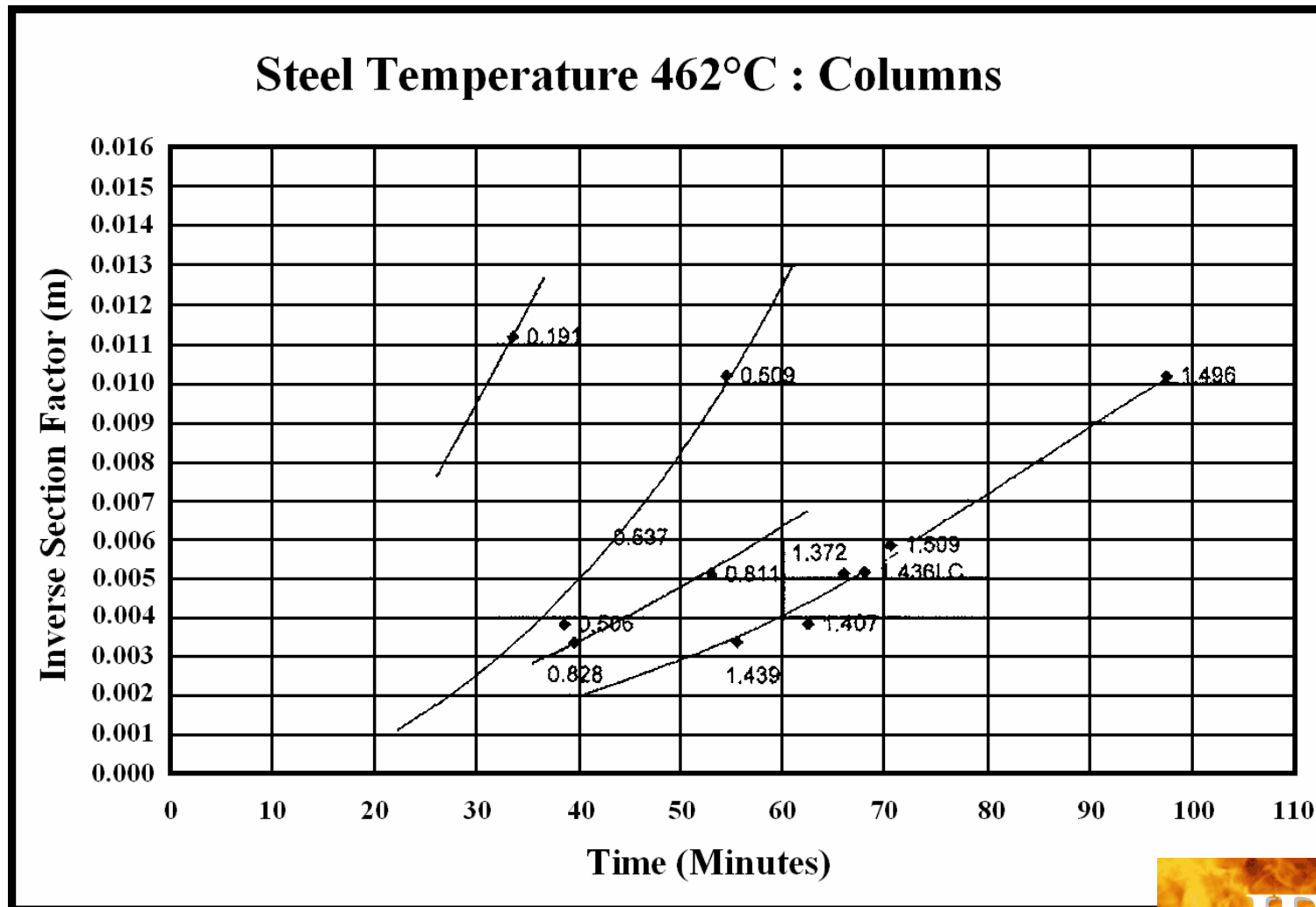


Figure 1 - UK Graphical Method by hand



Problems with the UK Graphical method

- Data points rarely have the same DFT
 - Data sets are manipulated to facilitate the method
- Three data points for a nominal DFT are rarely available
- A general trend is adopted
- The best fit – a straight line or curve?
- The position and shape of the best fit depends upon the assessors judgement

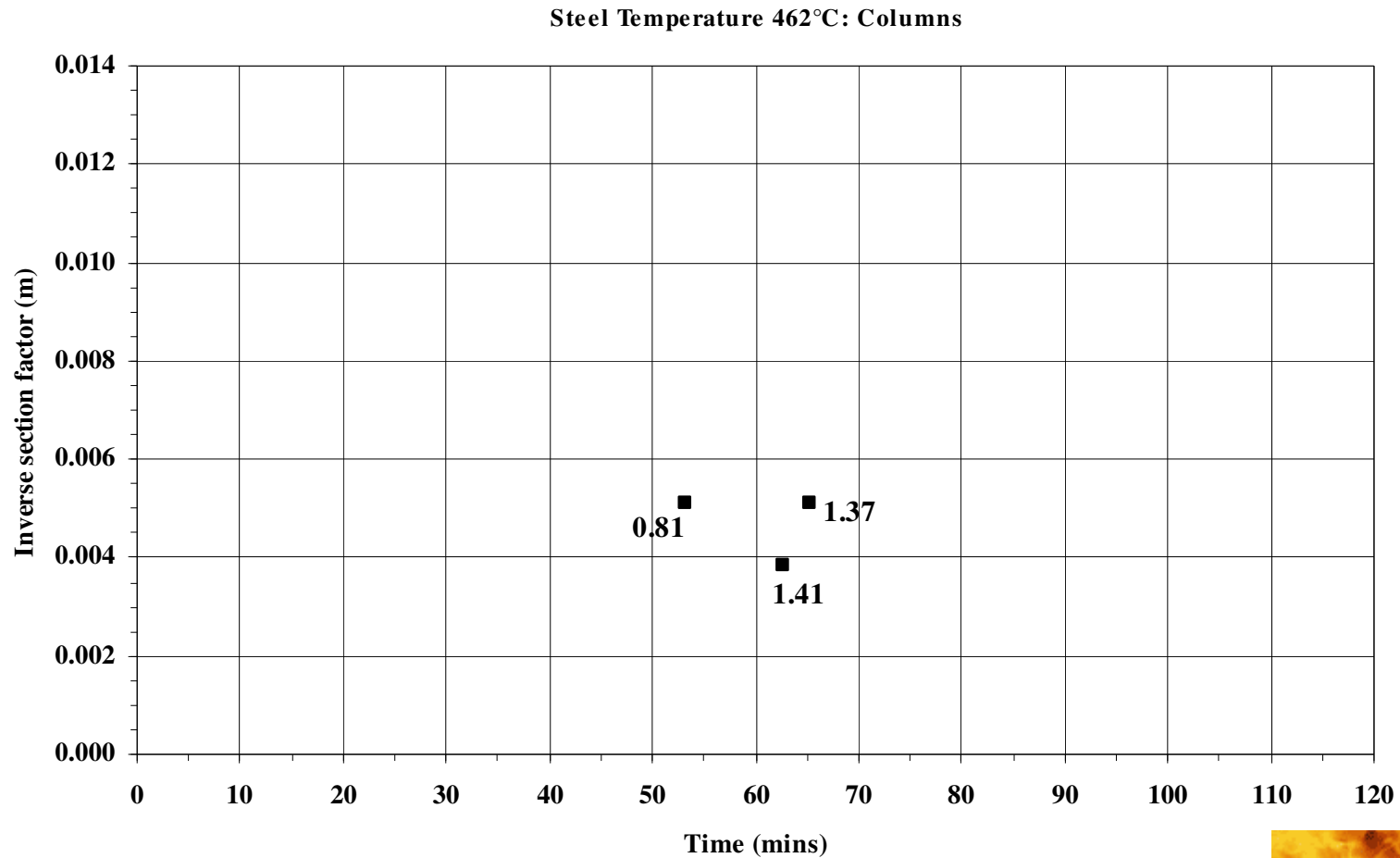


UK Graphical Method based upon two dimensional scatter plot

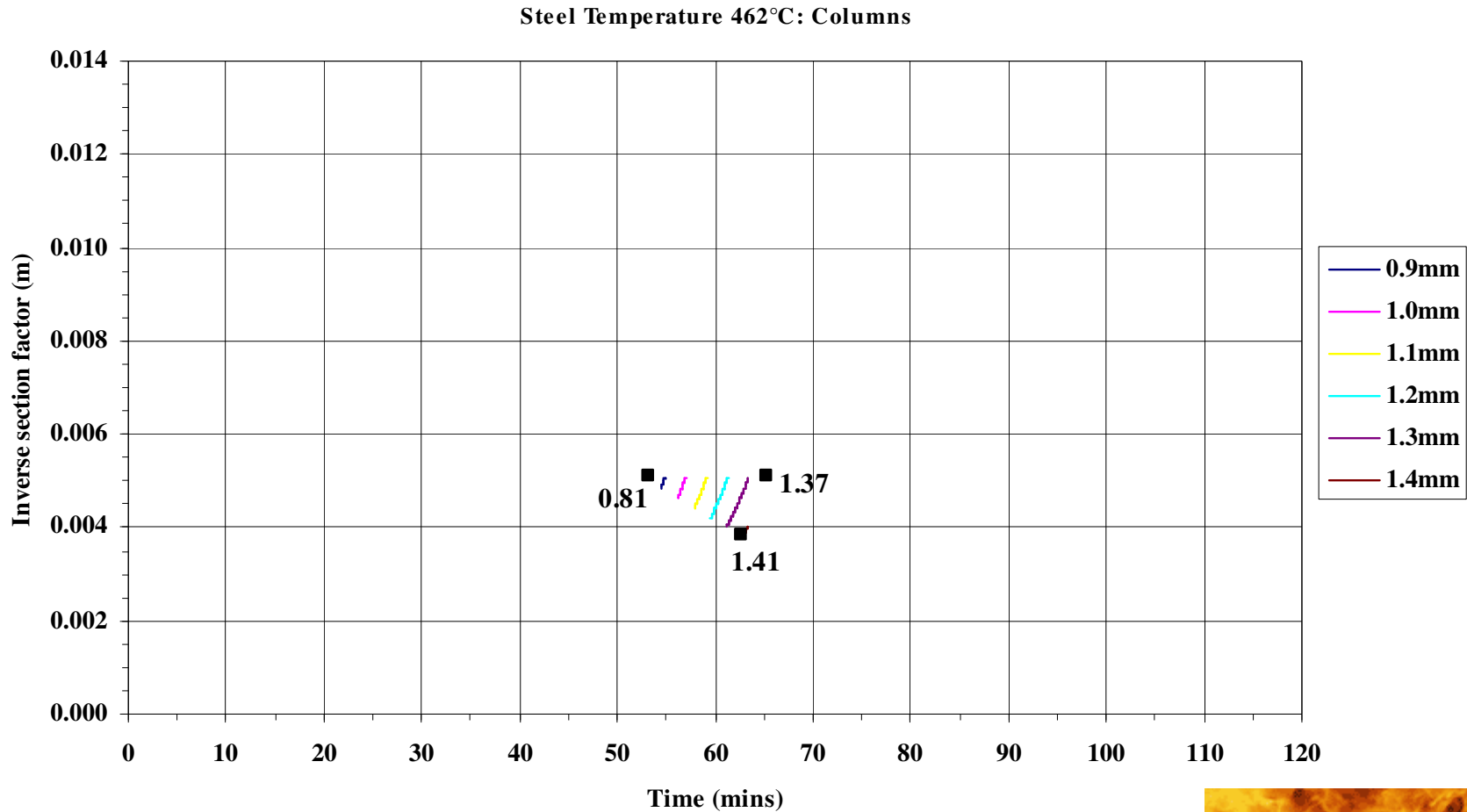
- Inverse Section Factor against Performance Time
- Example, consider three data points:
 - $(x_1, y_1) = (\text{time}_1, V/A_1) = (65, 0.005097)$ with DFT = 1.372mm
 - $(x_2, y_2) = (\text{time}_2, V/A_2) = (53, 0.005084)$ with DFT = 0.811mm
 - $(x_3, y_3) = (\text{time}_3, V/A_3) = (63, 0.003846)$ with DFT = 1.407mm
- The problem is to plot the performance for DFTs of 0.9, 1.0, 1.1, 1.2, 1.3 and 1.4mm
- Interpolation by hand allows the performance to be plotted



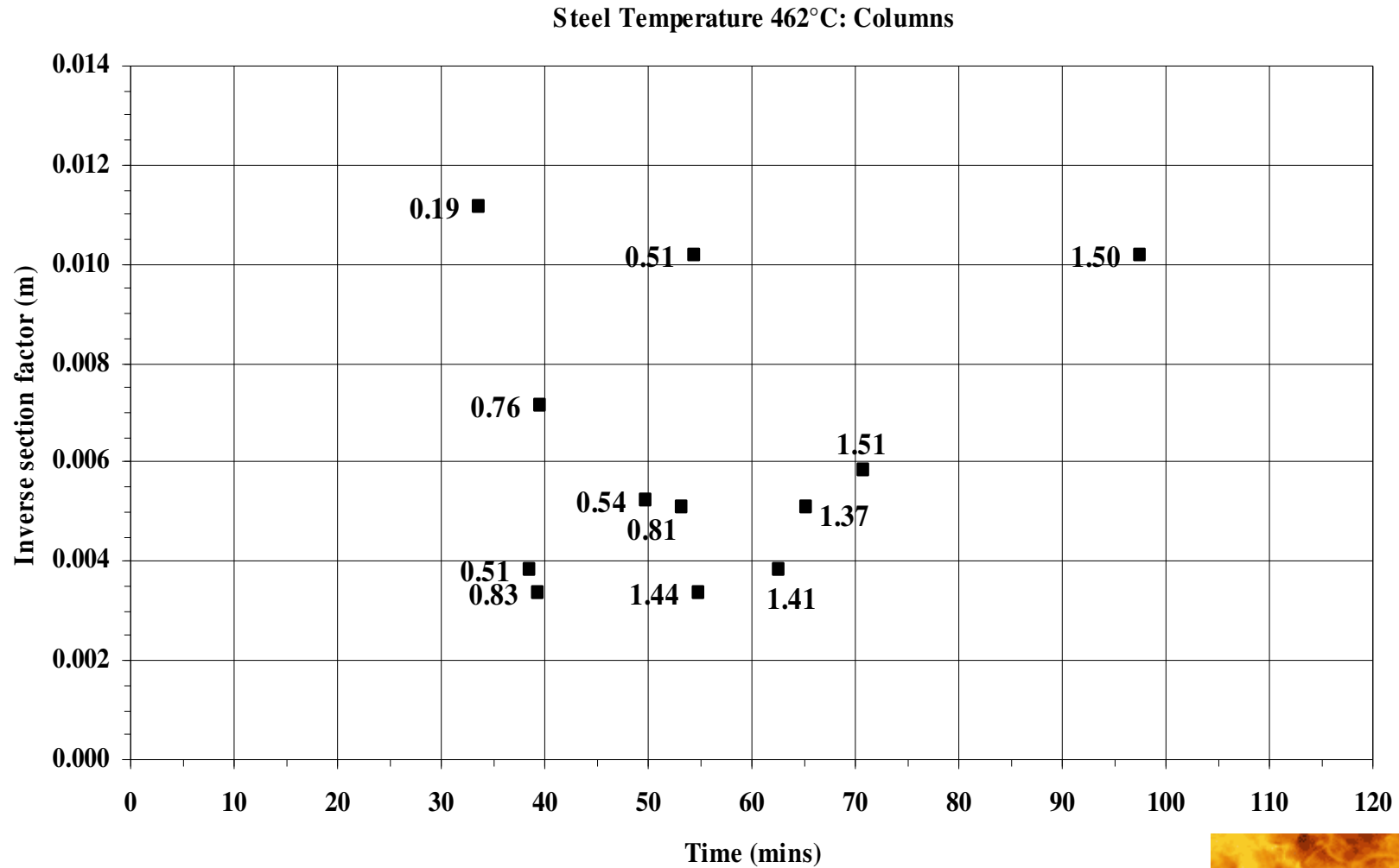
UK Graphical Method based upon two dimensional scatter plot



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UK Graphical Method based upon two dimensional scatter plot



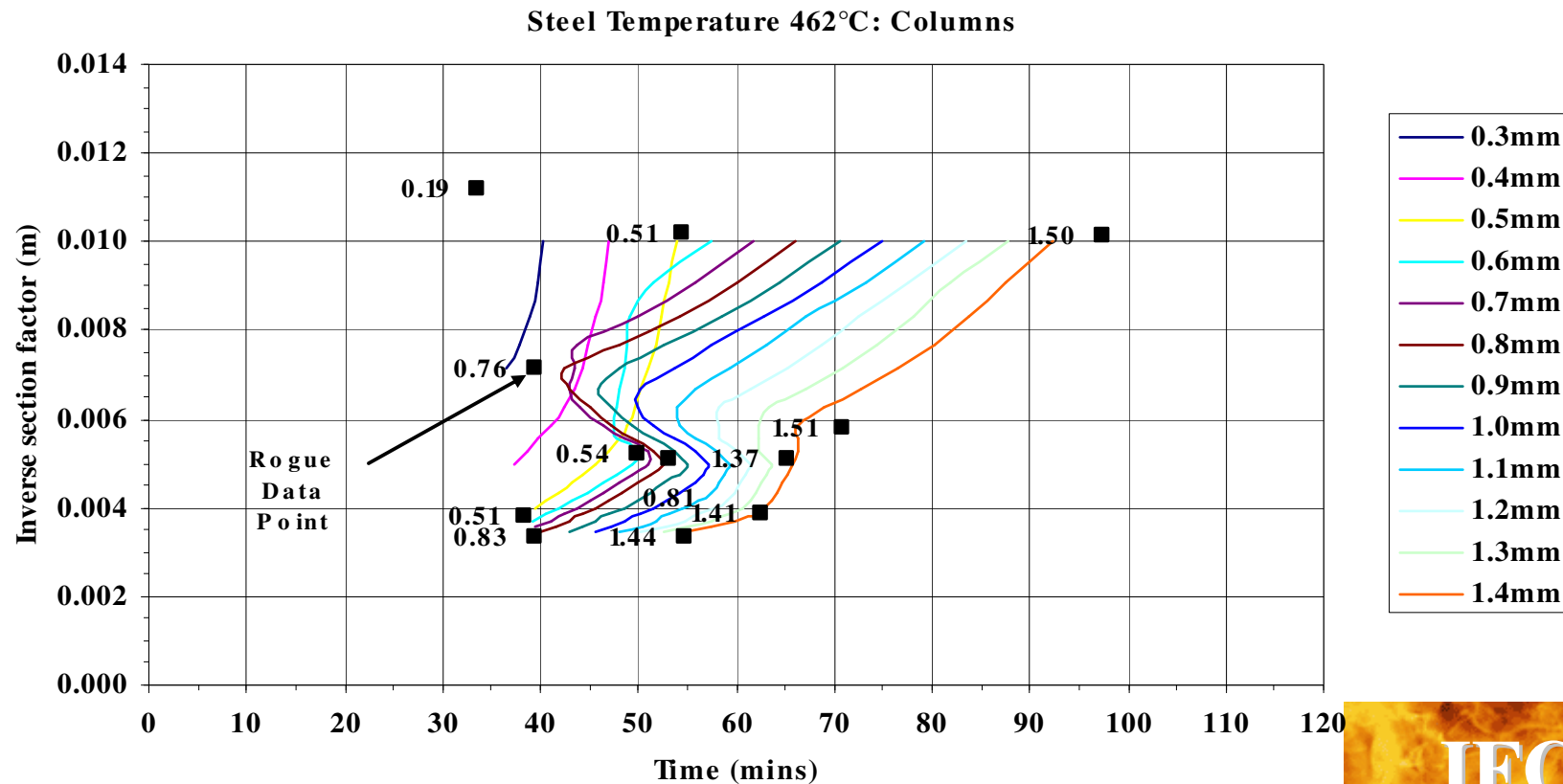
Rogue data points

- Rogue data points are beyond the scope of the method when carried out by hand
- Data points are often omitted for this reason
- Algorithm developed by IFC can handle this



Conflicting positions of data points

- In some cases the data points do not fit the expected pattern

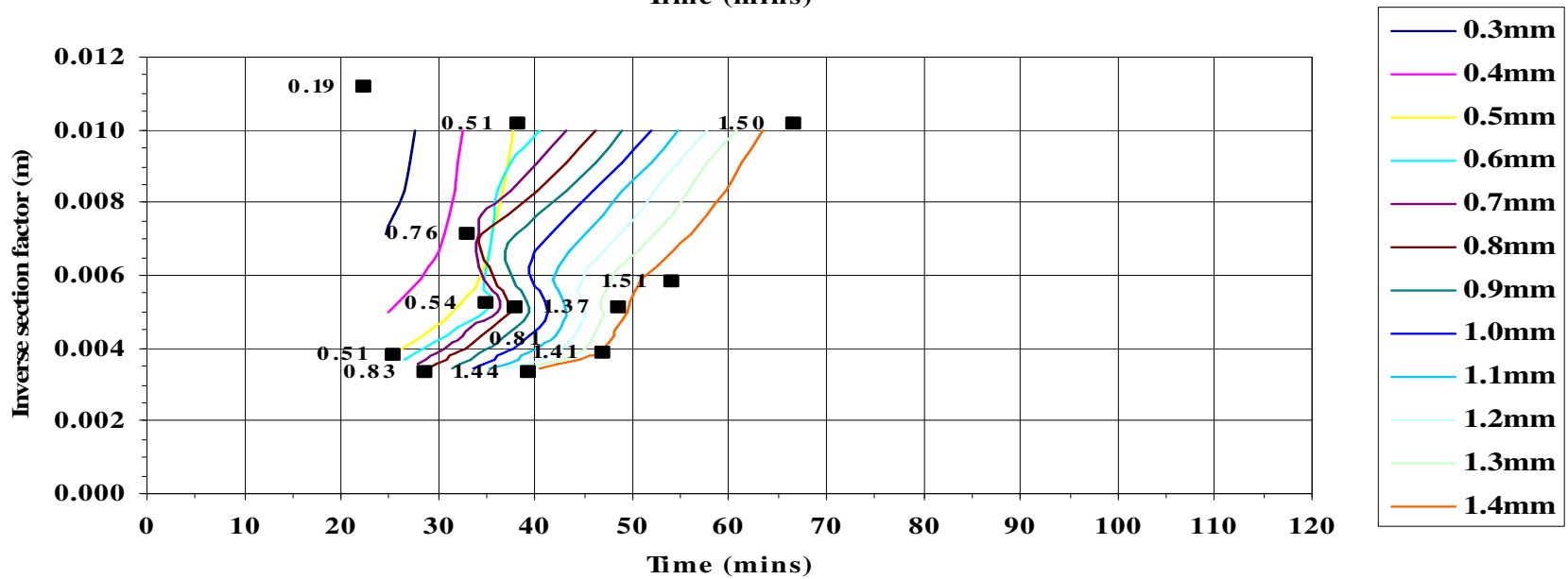
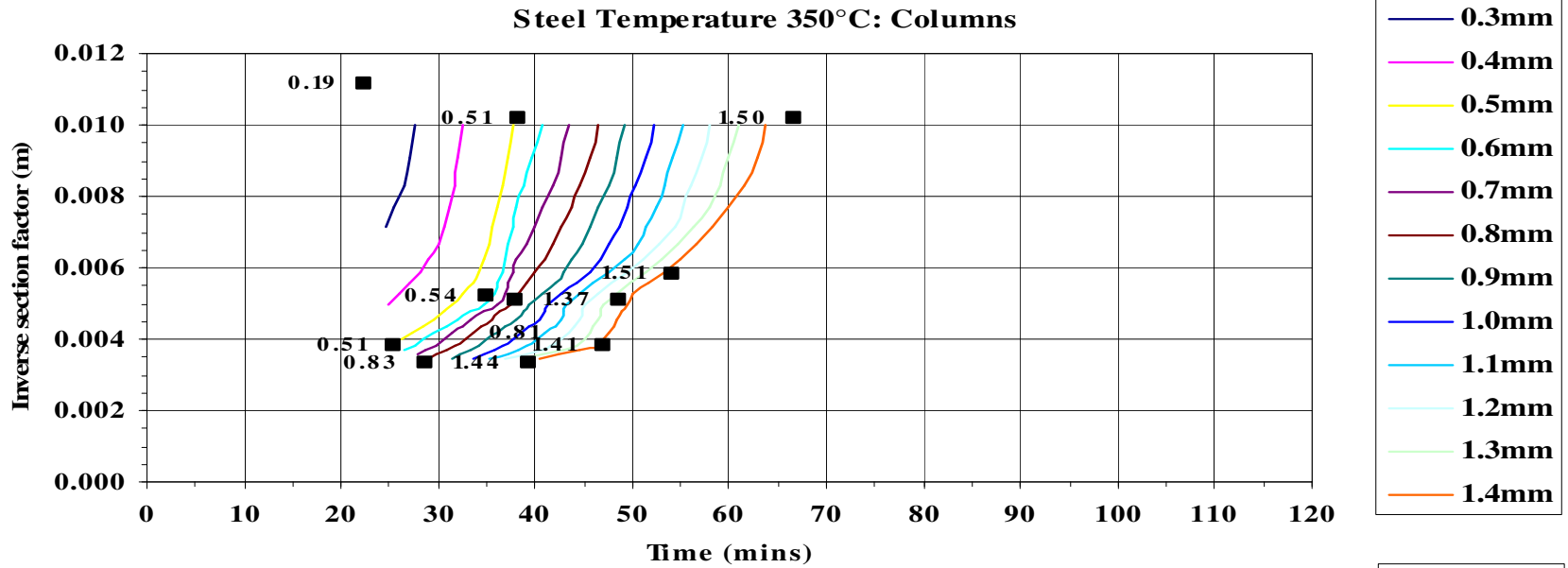


Algorithm for UK Graphical Method developed by IFC

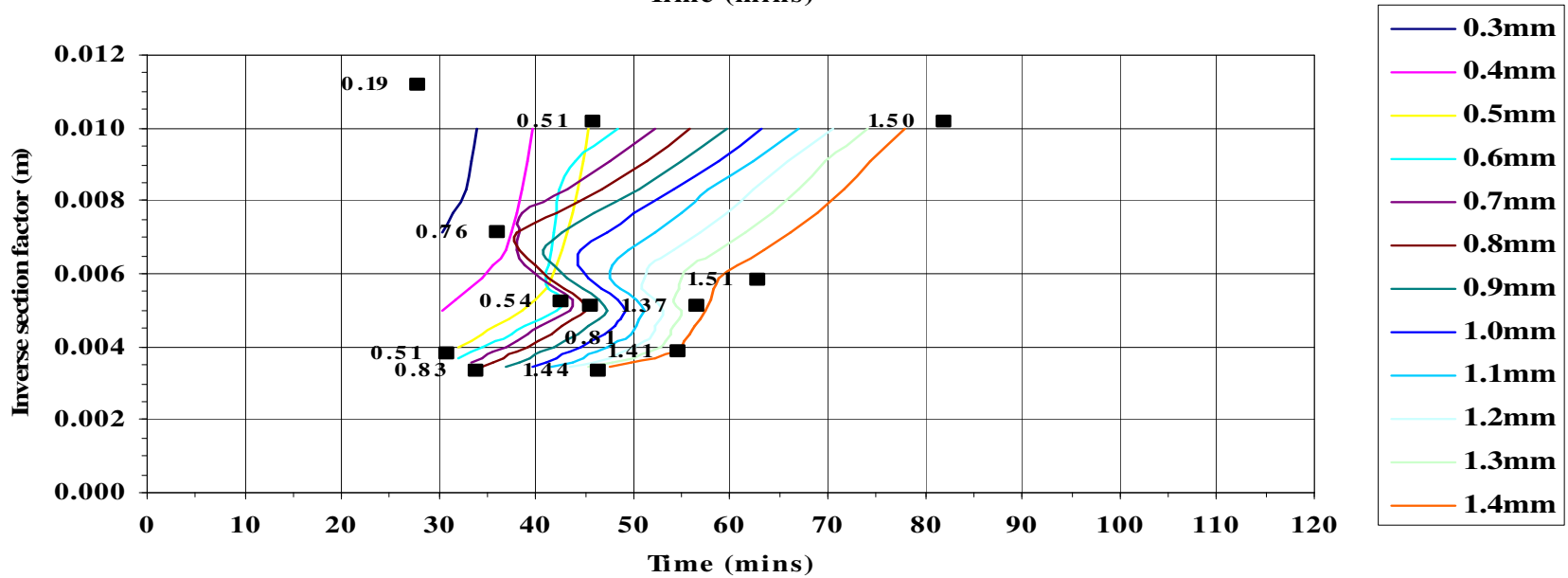
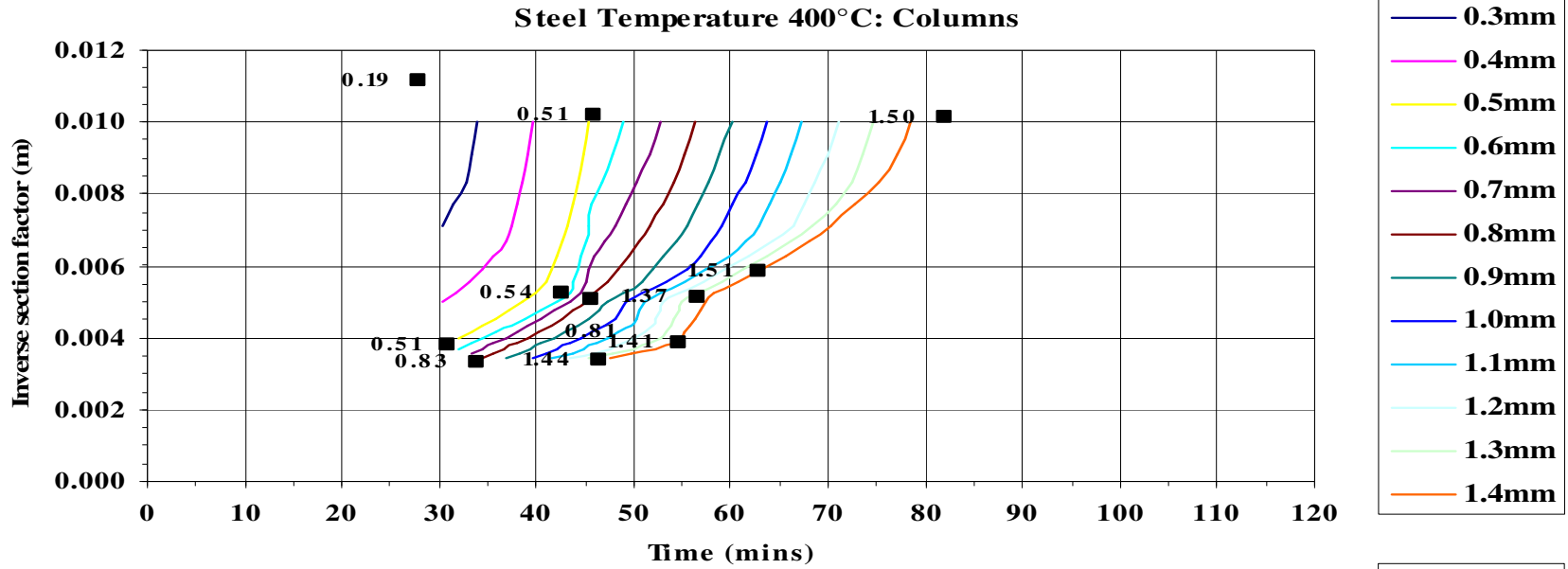
- Current method attempts to solve a 3-dimensional problem in a 2-dimensional format
- IFC Algorithm allows for 3-dimensions to be considered
 - Accounts for relationship between Inverse Section Factor and Performance time
 - Accounts for relationship between Inverse Section Factor and DFT
 - Accounts for the relationship between DFT and Performance time



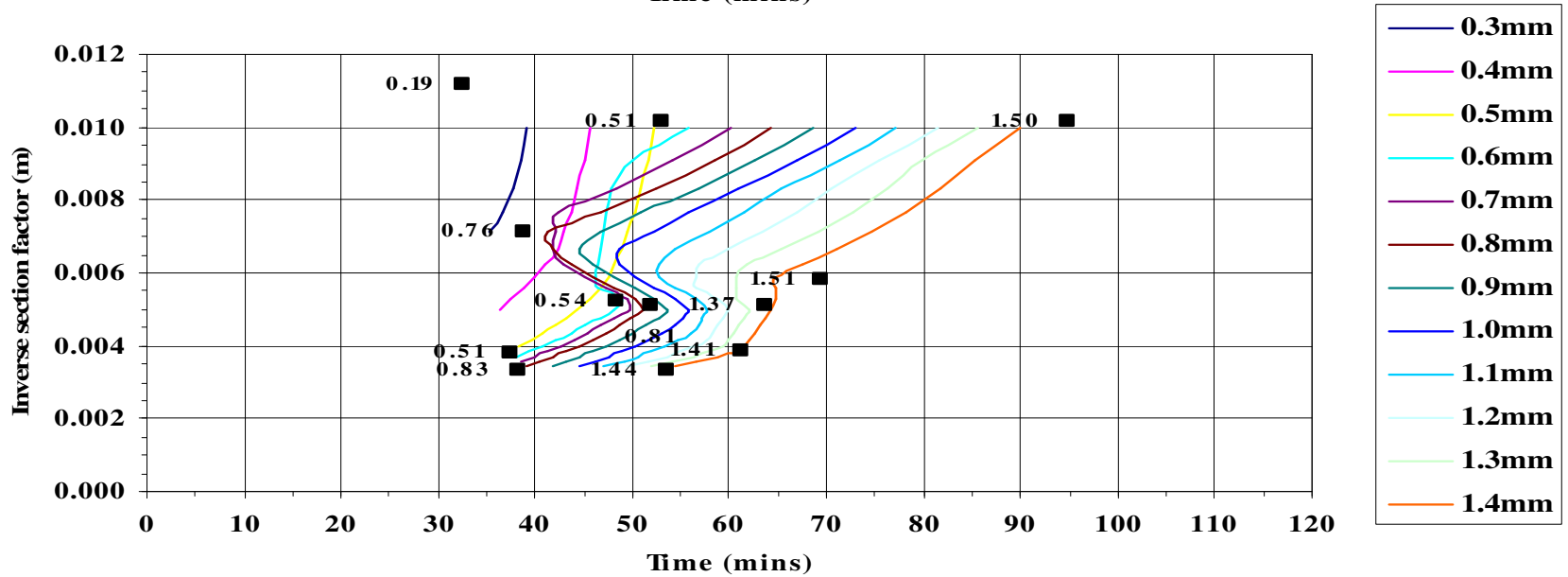
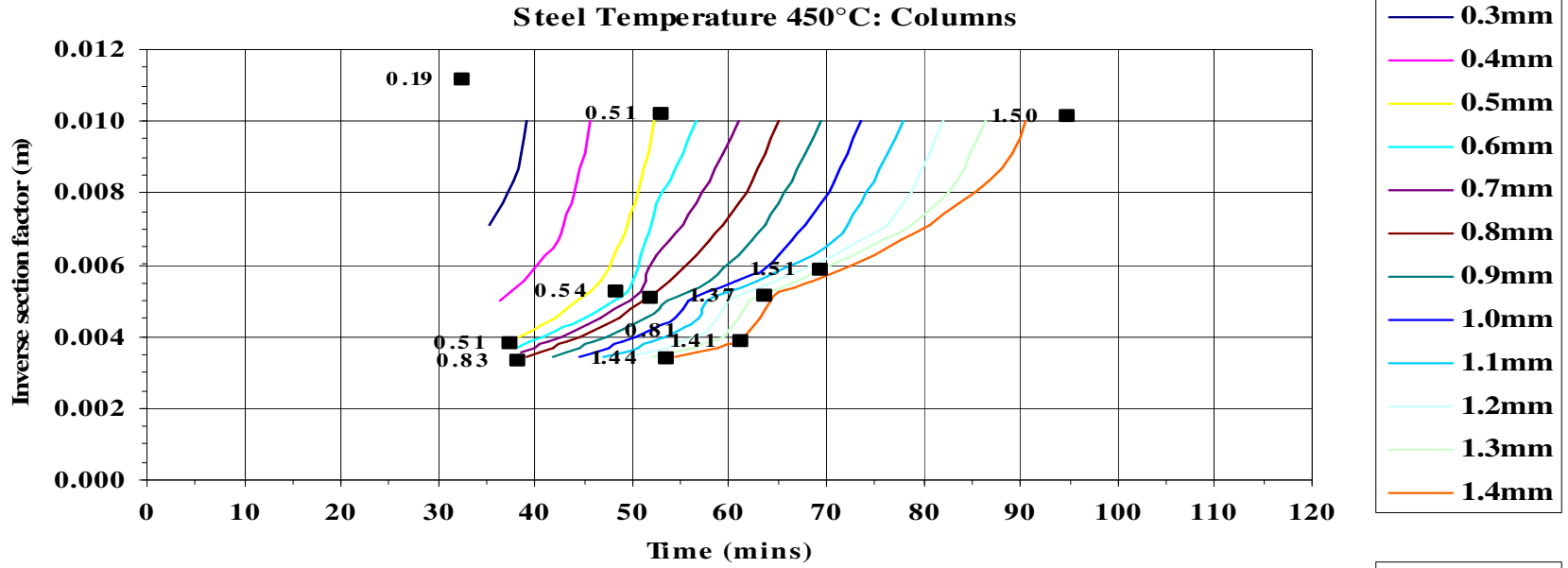
Example Data Sets



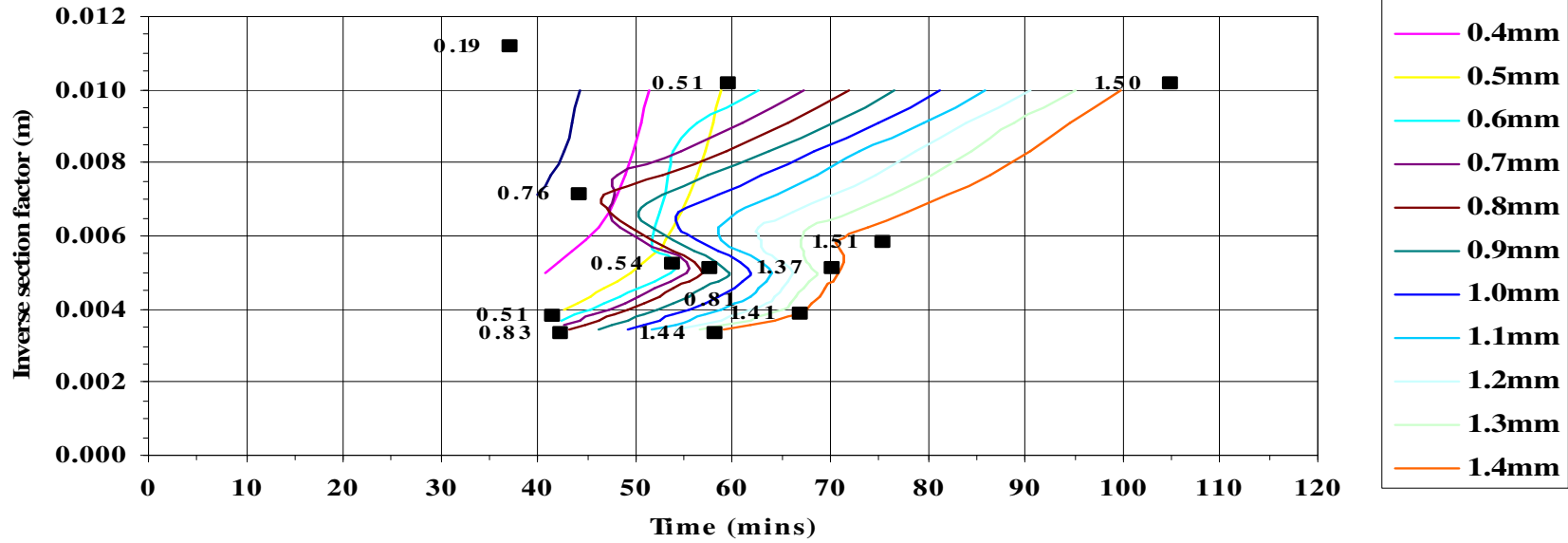
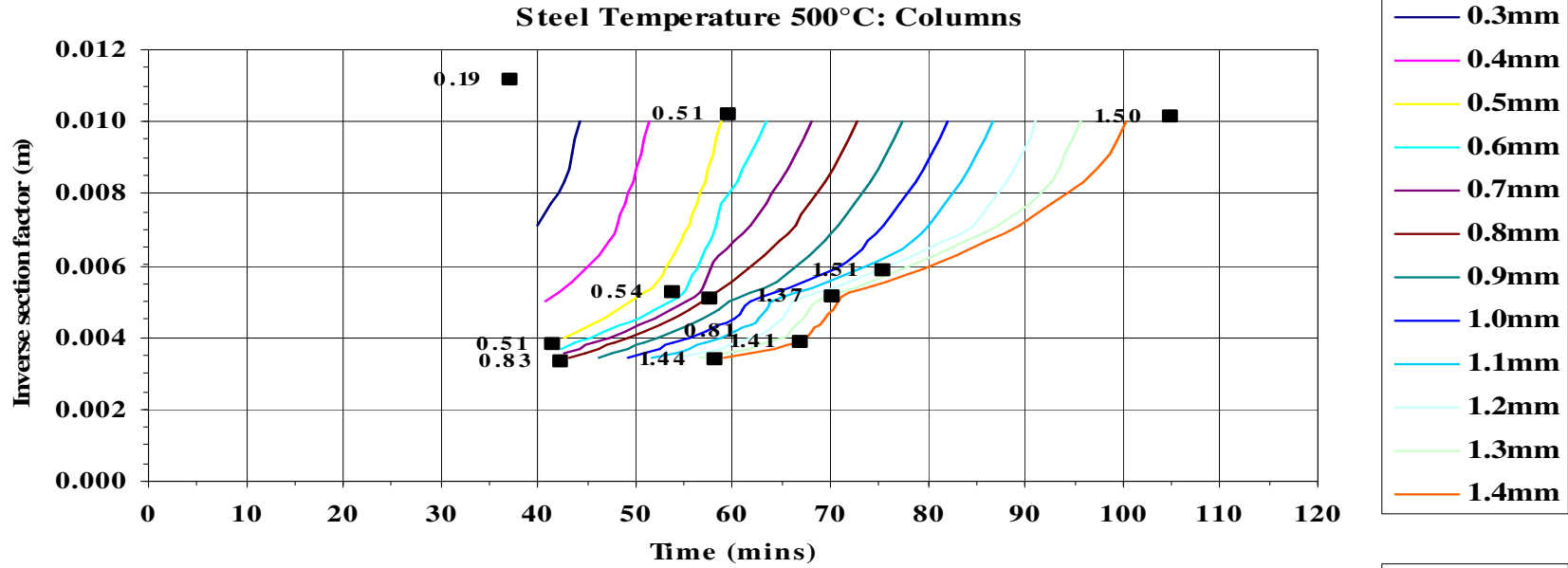
Example Data Sets



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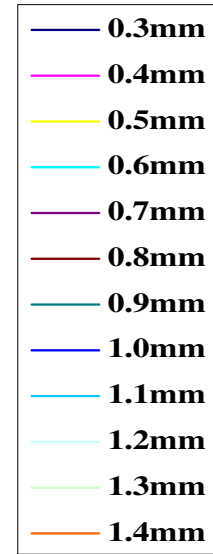
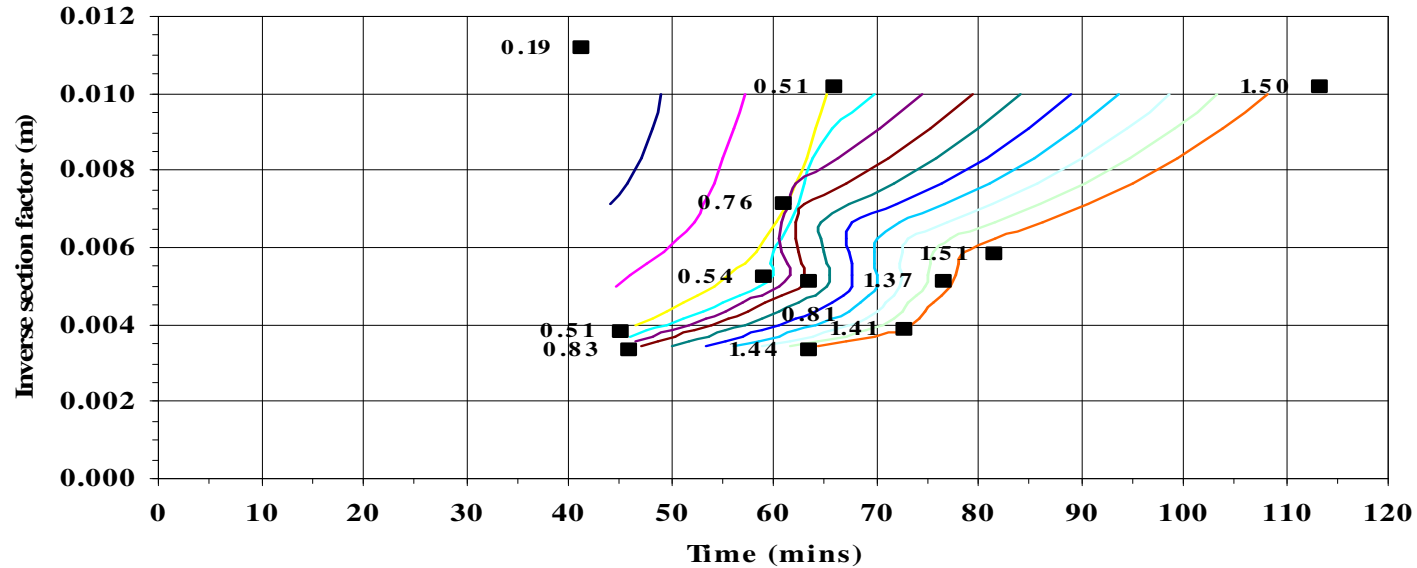
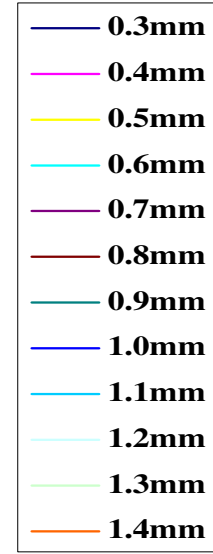
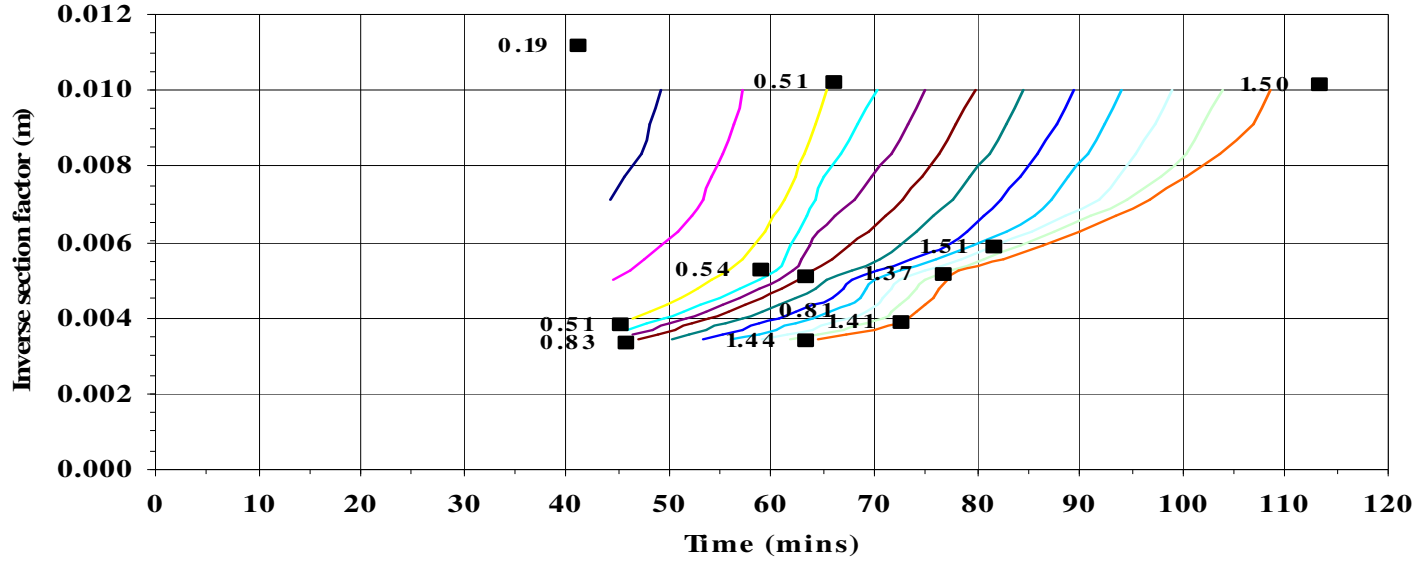


Example Data Sets

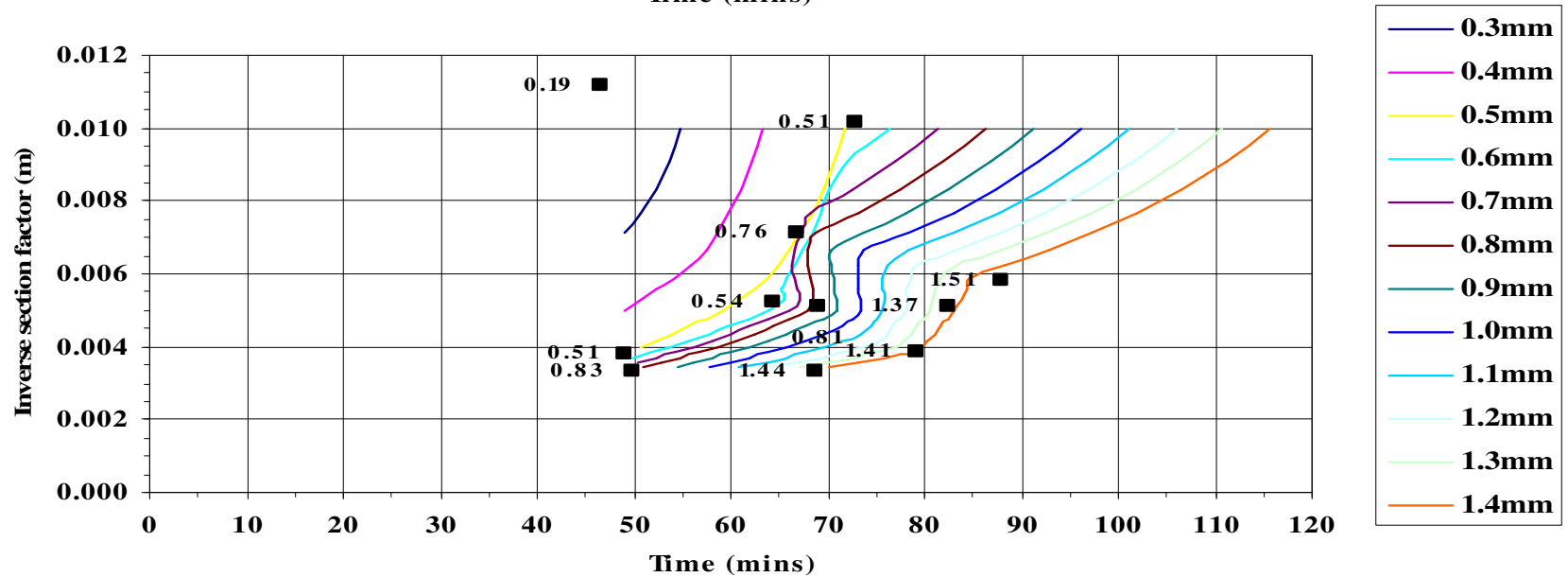
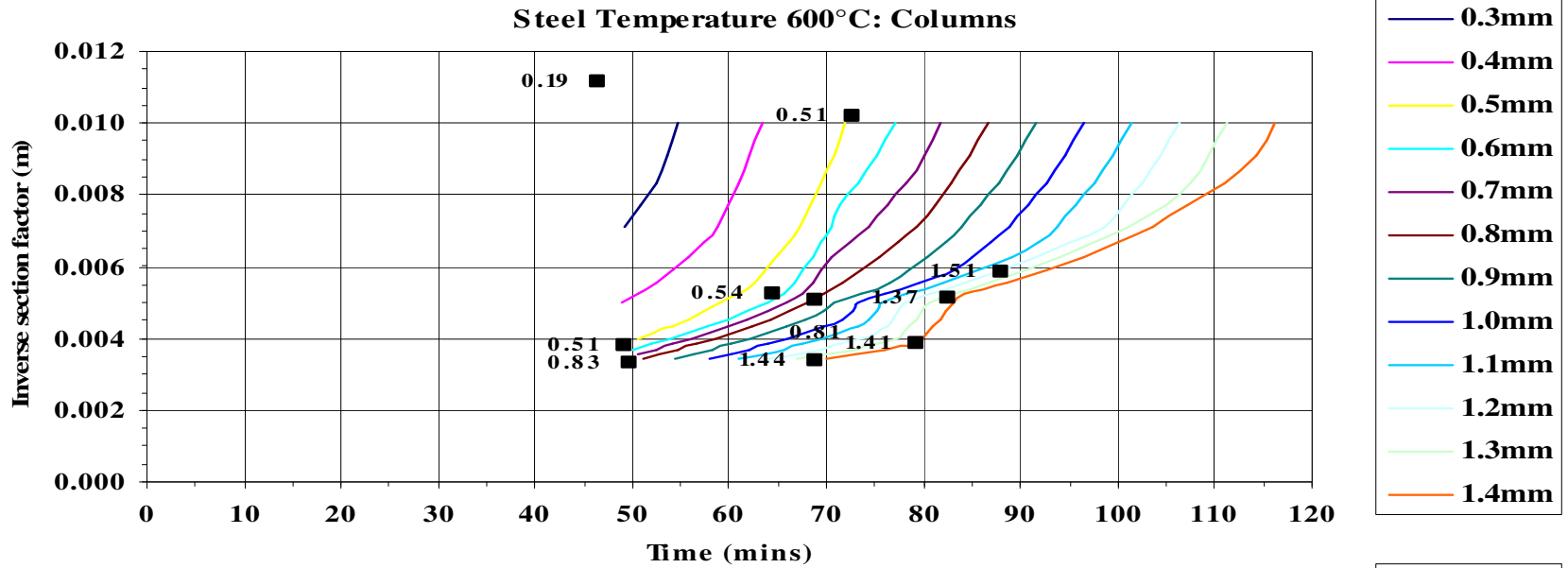


Example Data Sets

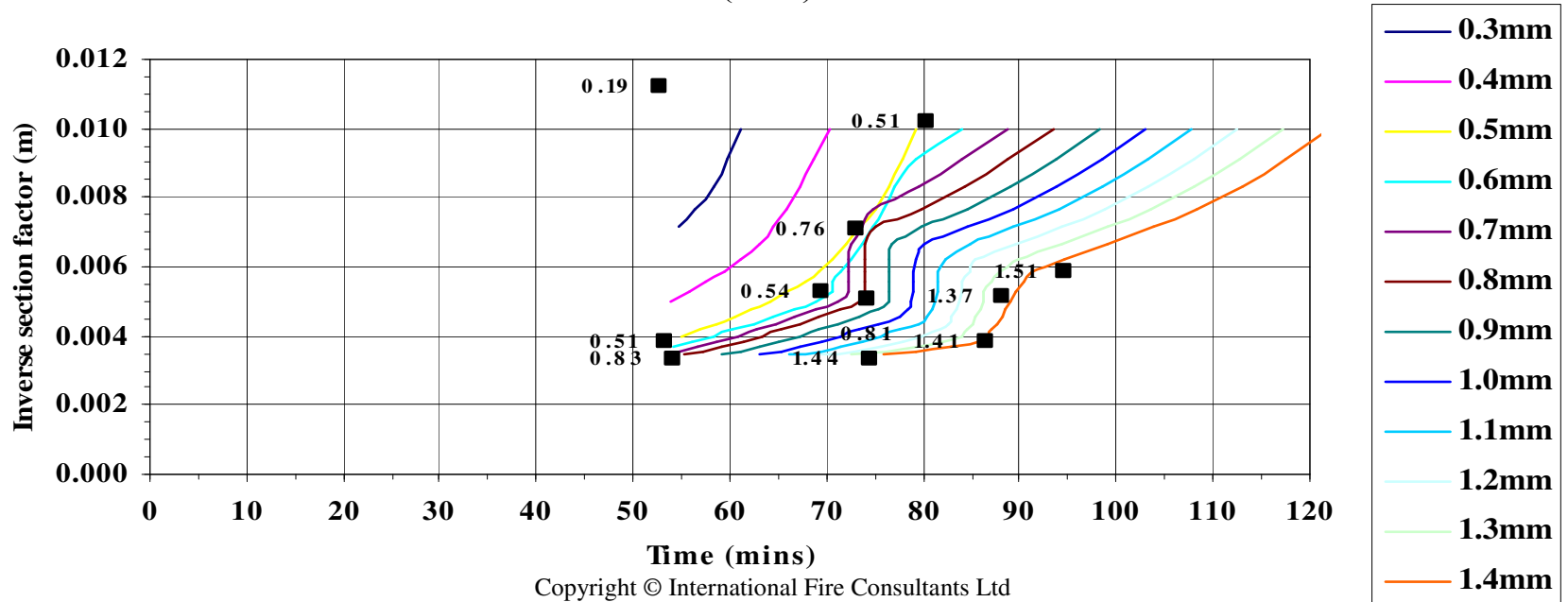
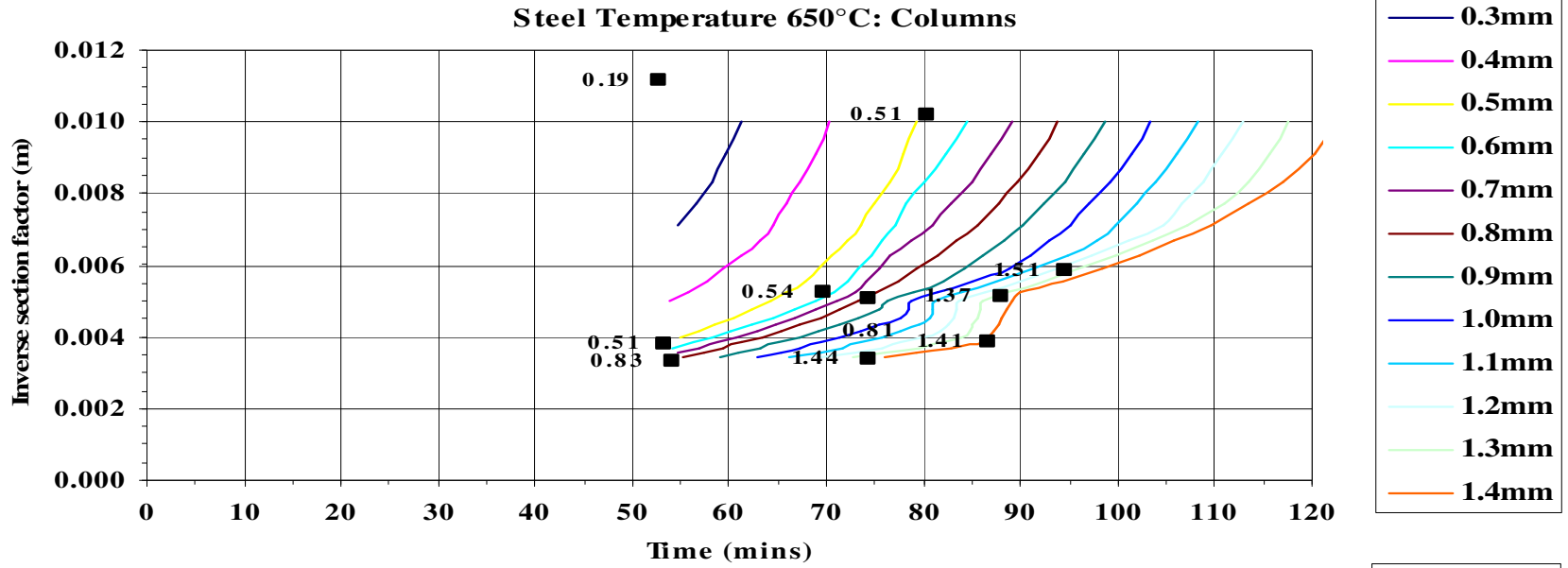
Steel Temperature 550°C: Columns



Example Data Sets

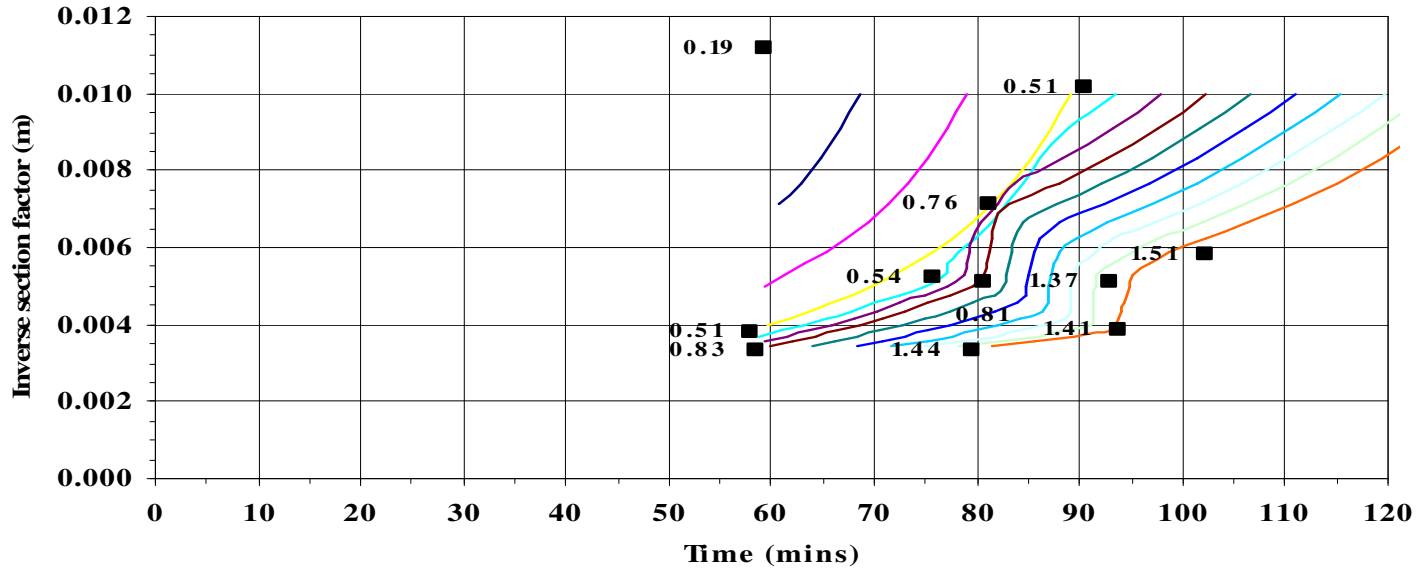
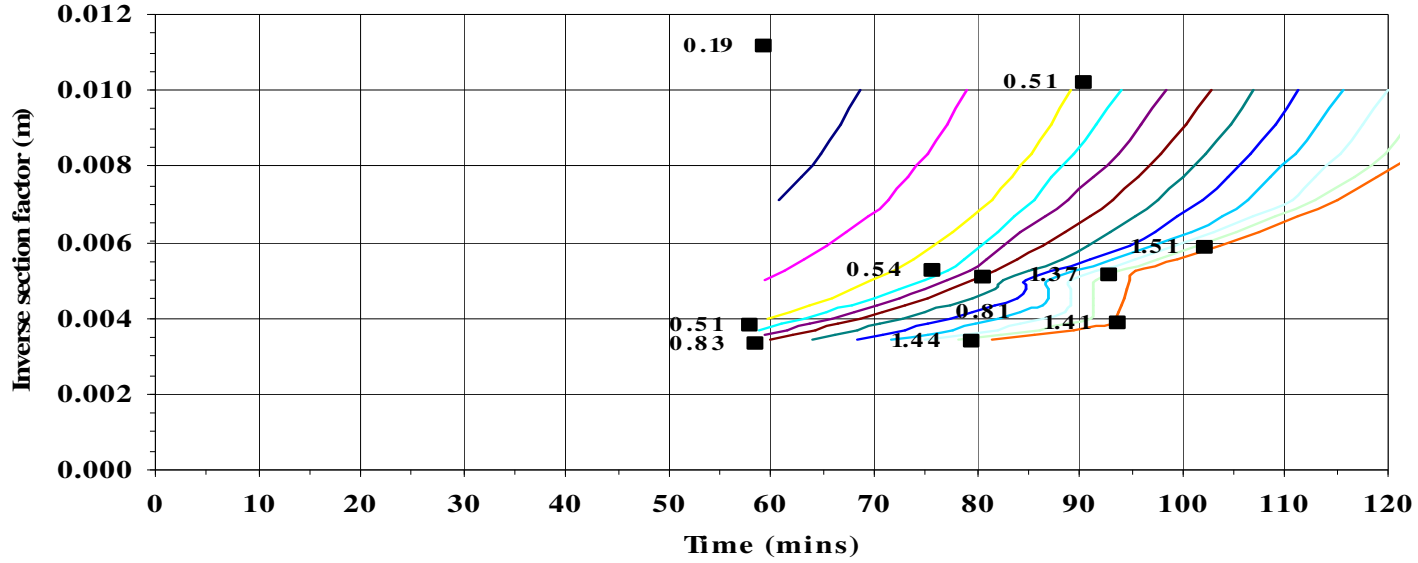


Example Data Sets



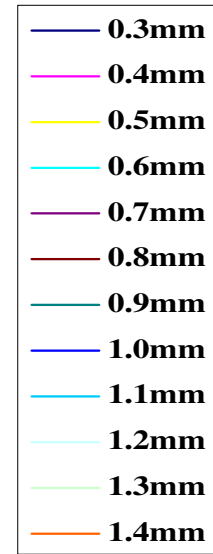
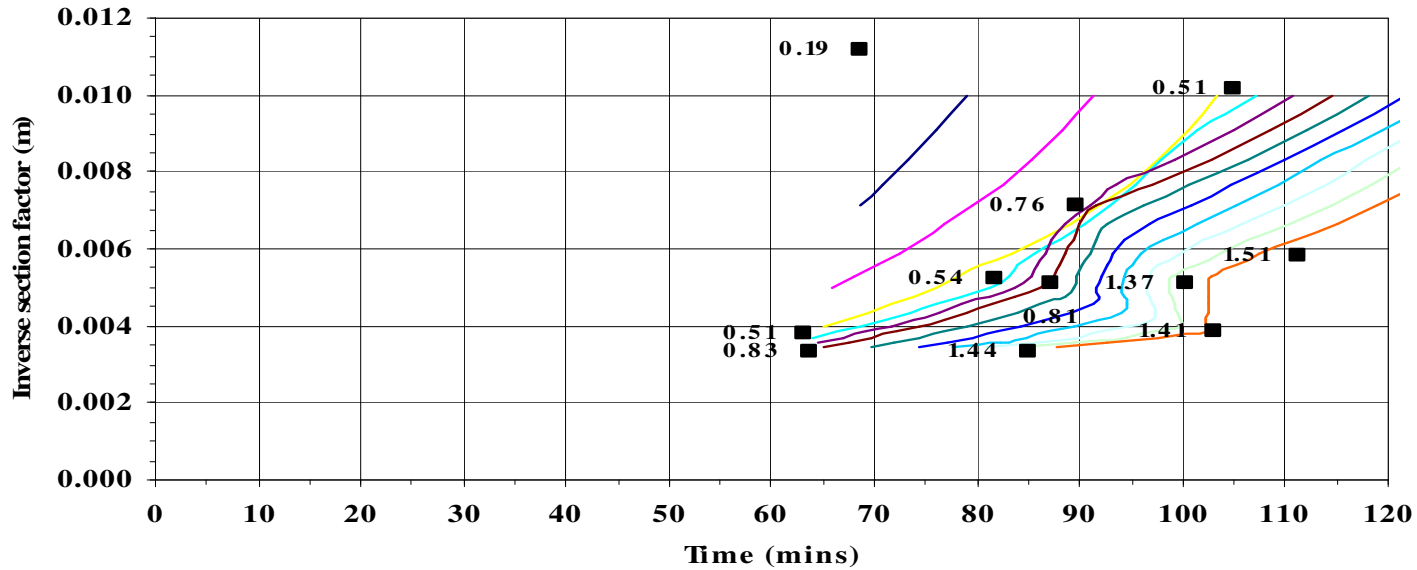
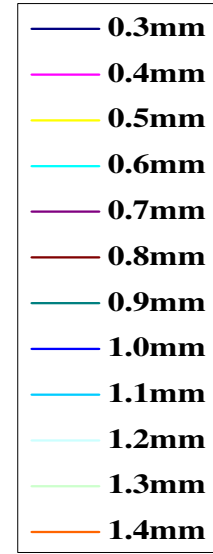
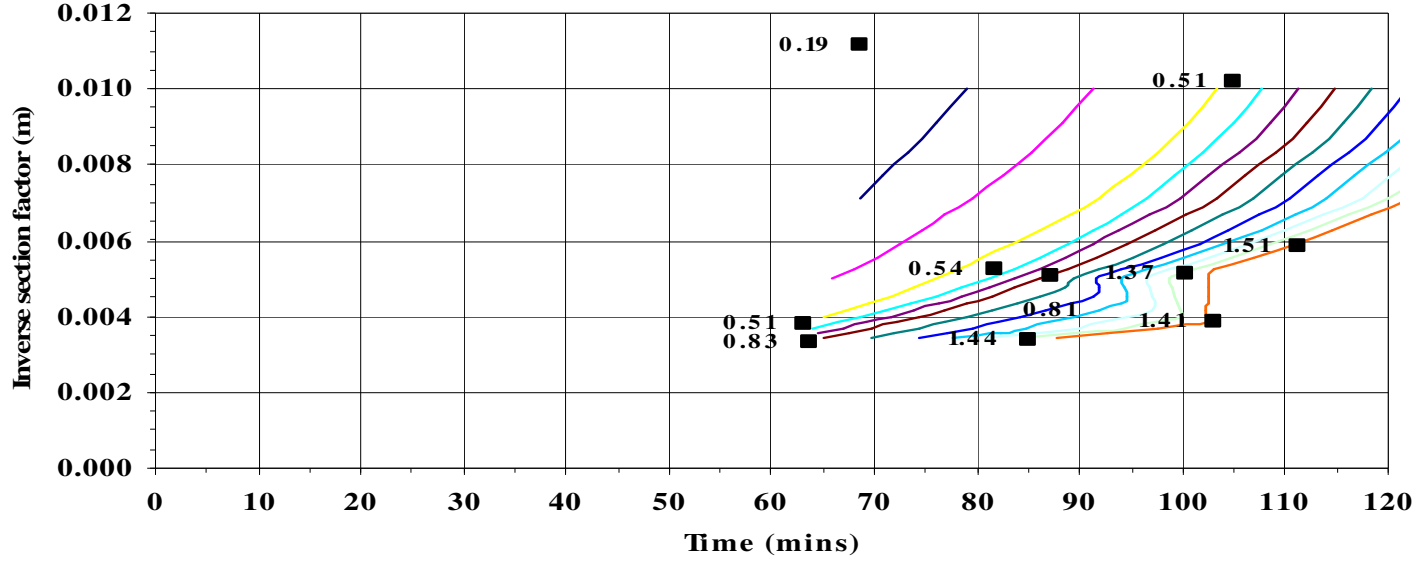
Example Data Sets

Steel Temperature 700°C: Columns



Example Data Sets

Steel Temperature 750°C: Columns



Checking existing data sets and assessments based on the UK Graphical Method carried out by hand

- Checking can be carried out quickly
- Comparison shows:
 - The curves are not curves at all
 - Data points are frequently omitted
 - Manipulation of data introduces inaccuracy



Advantages of using the algorithm for the UK Graphical Method

- Exact prediction
- No manipulation of data to facilitate use of the method
- No need to omit data
- Repeatability
- Independent of the assessor
- No subjectivity, estimation or personal judgement



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automated assessment of intumescent coatings**

THANK YOU

ANY QUESTIONS?

