IPRO 330 - Operator Information Tool to Manage Heat Treat Furnace Parts for A. Finkl & Sons

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Leland Barnard, Bill Cappello, Zheyan Chen, Syed Ijaz, Patrick O'Leary, Colleen Roberts, Eddie Schwalbach, Ivan Tovalin, Josef Velten, Minaz Virani

Advisor: S. Mostovoy

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Outline

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- Problem description
- Furnace evaluation
- Software solutions
- Conclusions
- Future work

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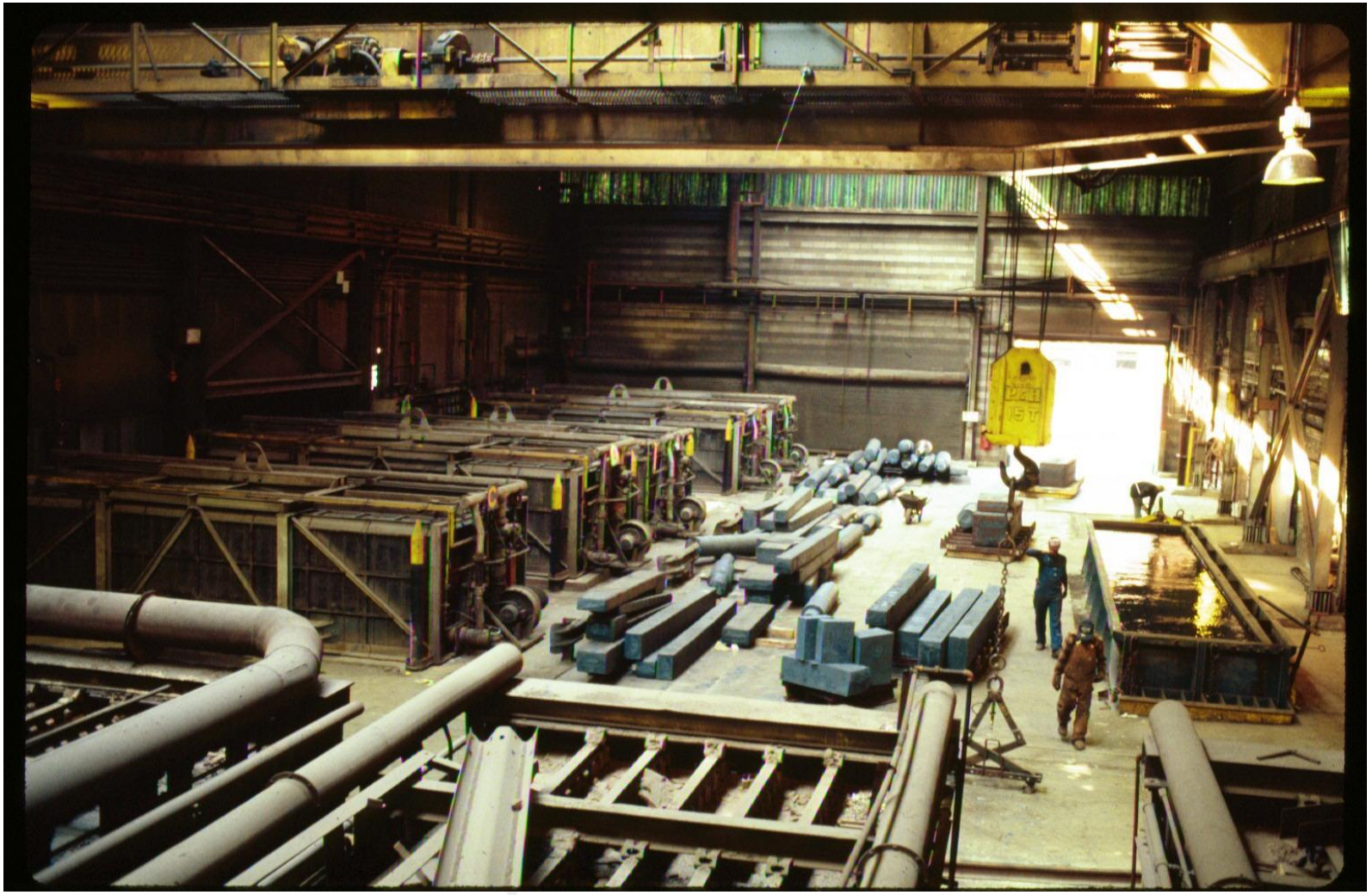

The Problem

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- The tempering process
  - Production bottleneck
  - Some parts not up to specification
  - Furnace stacking is suspected to be the cause
- Stacking records: “pen and paper” method
  - Not effective
  - No way to correlate configuration with failures

Project Objectives

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- Furnace Analysis:
  - Why do certain piece not achieve proper hardness after heat treatment?
  - Are the failures systematic?
- Software Development:
  - Better record keeping
  - Individual piece tracking

Problem solving approach: Furnace Analysis

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- Furnace survey:
  - Empty furnace
  - Loaded furnace
- Furnace temperature range specification
- Characteristic temper curves for specific steel alloys

Problem Solving Approach: Software Solutions

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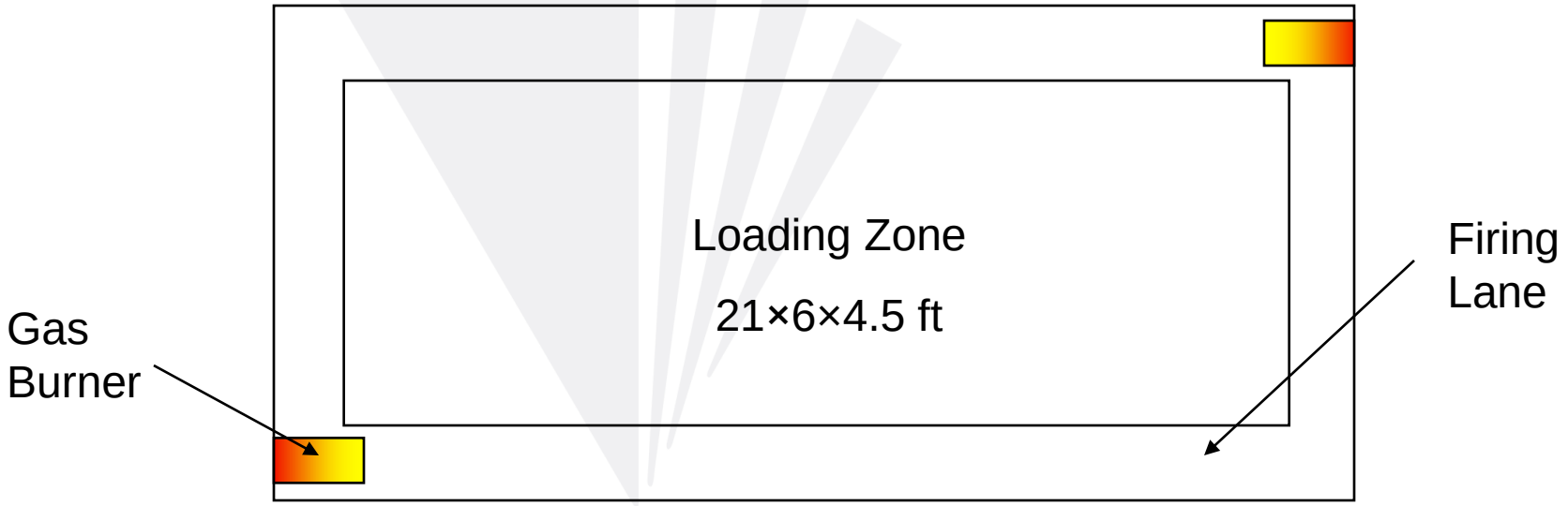
- Currently available software solutions
- Potential development kits
  - OpenGL
  - VTK
  - ACIS
- Foreseeable snags
  - Collision detection
  - Database interfacing

Furnace Survey Overview

- Furnace surveys were performed to determine the temperature distributions in the tempering furnaces
- Surveys were performed both in an unloaded and loaded furnace
- Approximately 20 thermocouples were used for each survey



Furnace Model

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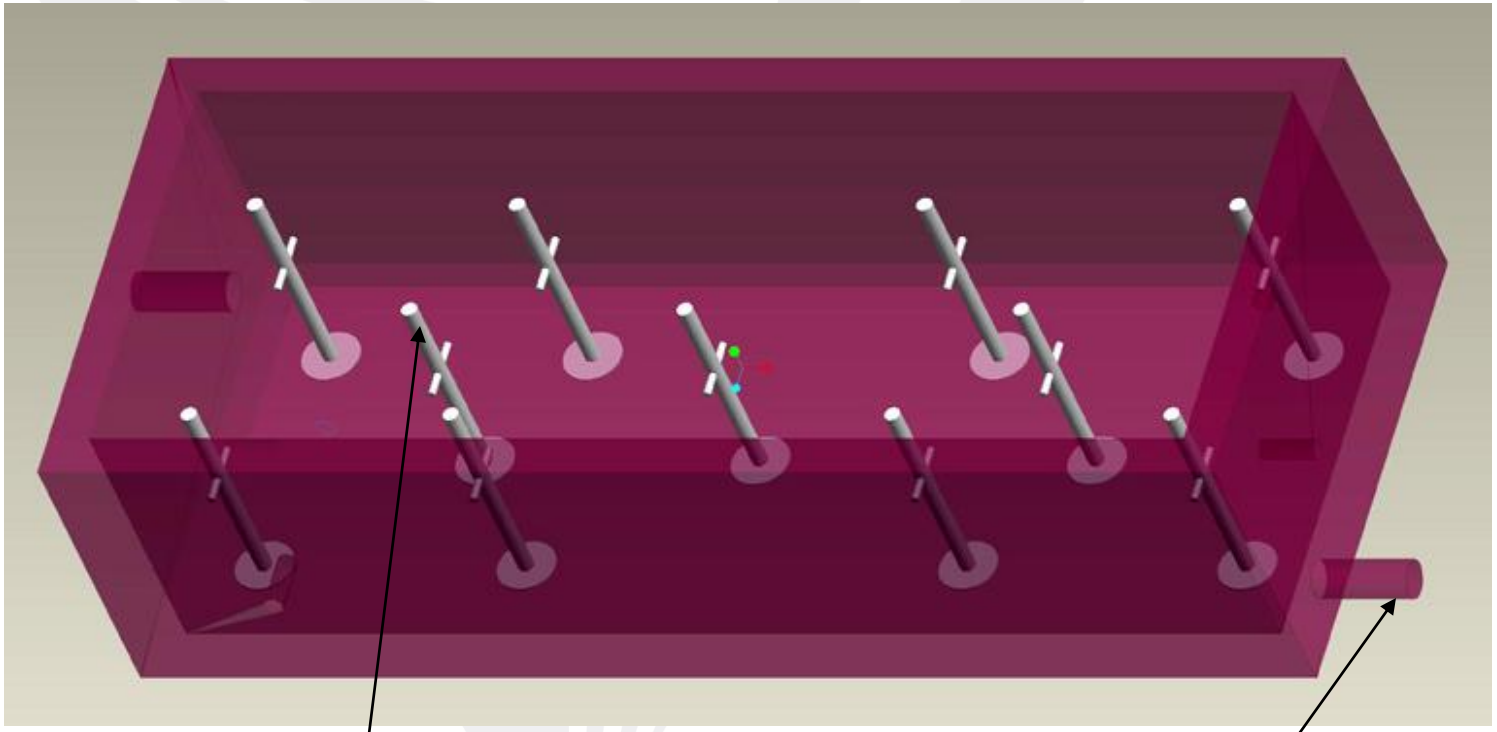

Temperature Distributions

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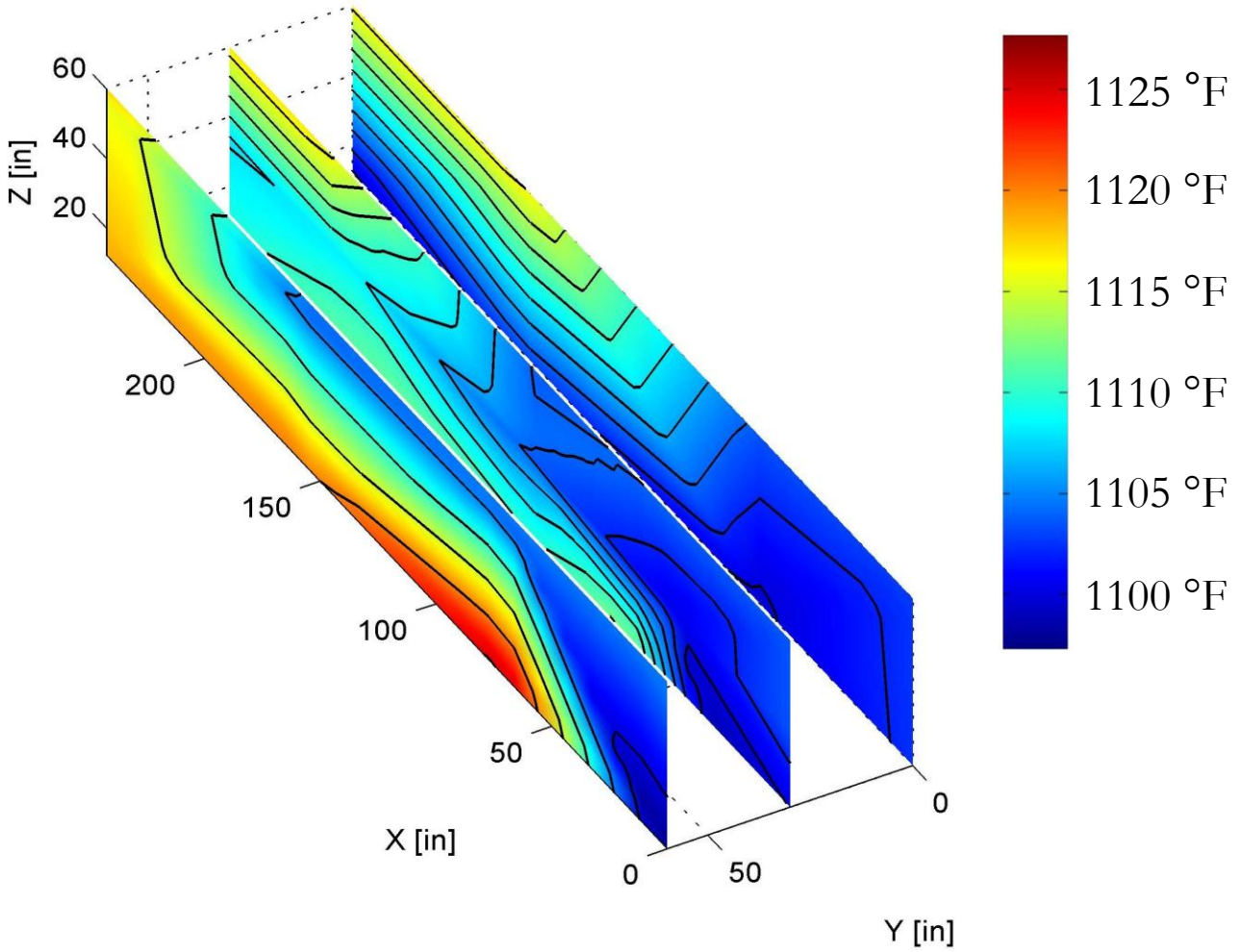
Unloaded 1100°F Set Point



Temperature Distributions

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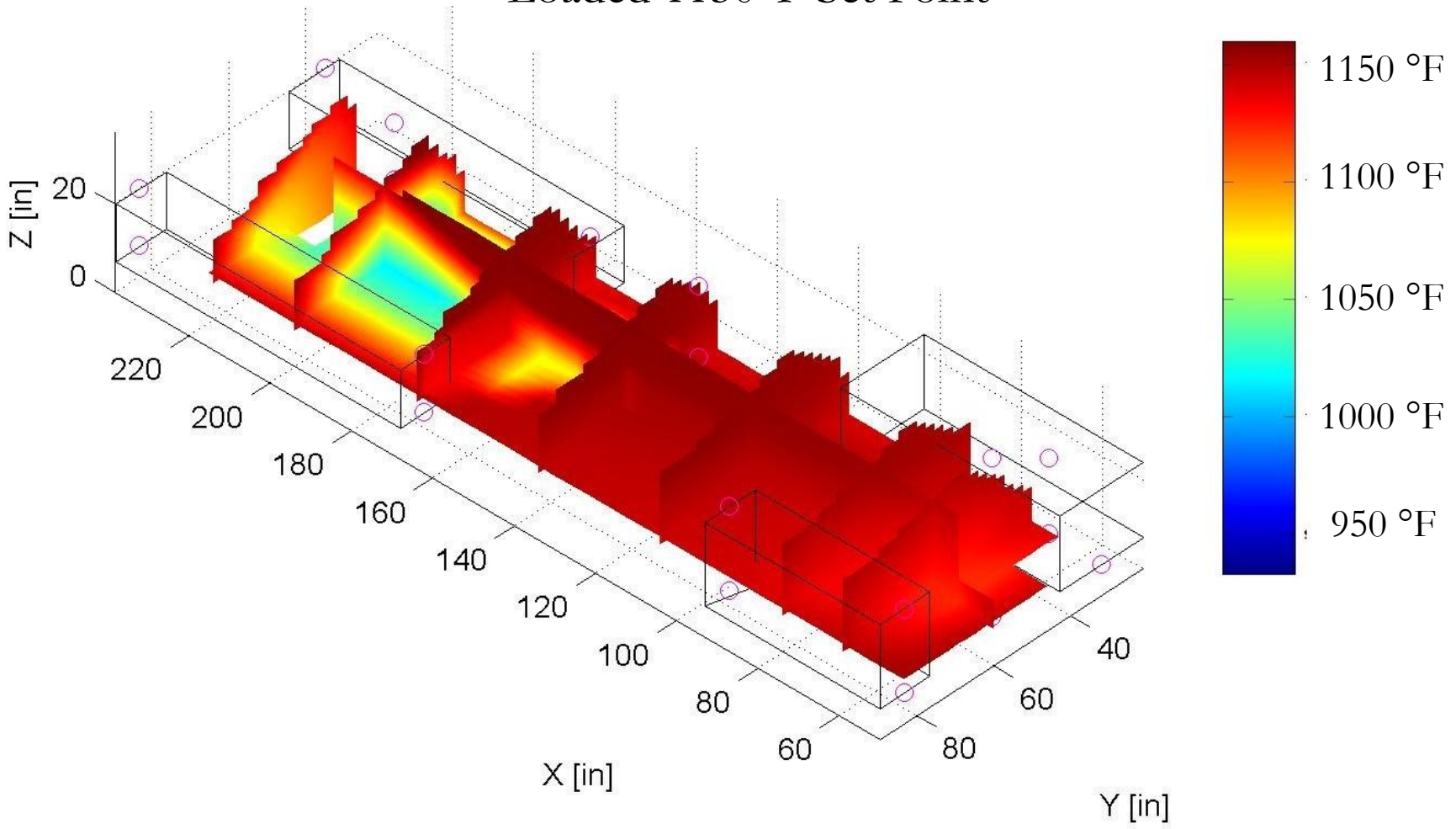
Loaded 1150°F Set Point



Shelldie® Tempering Curve

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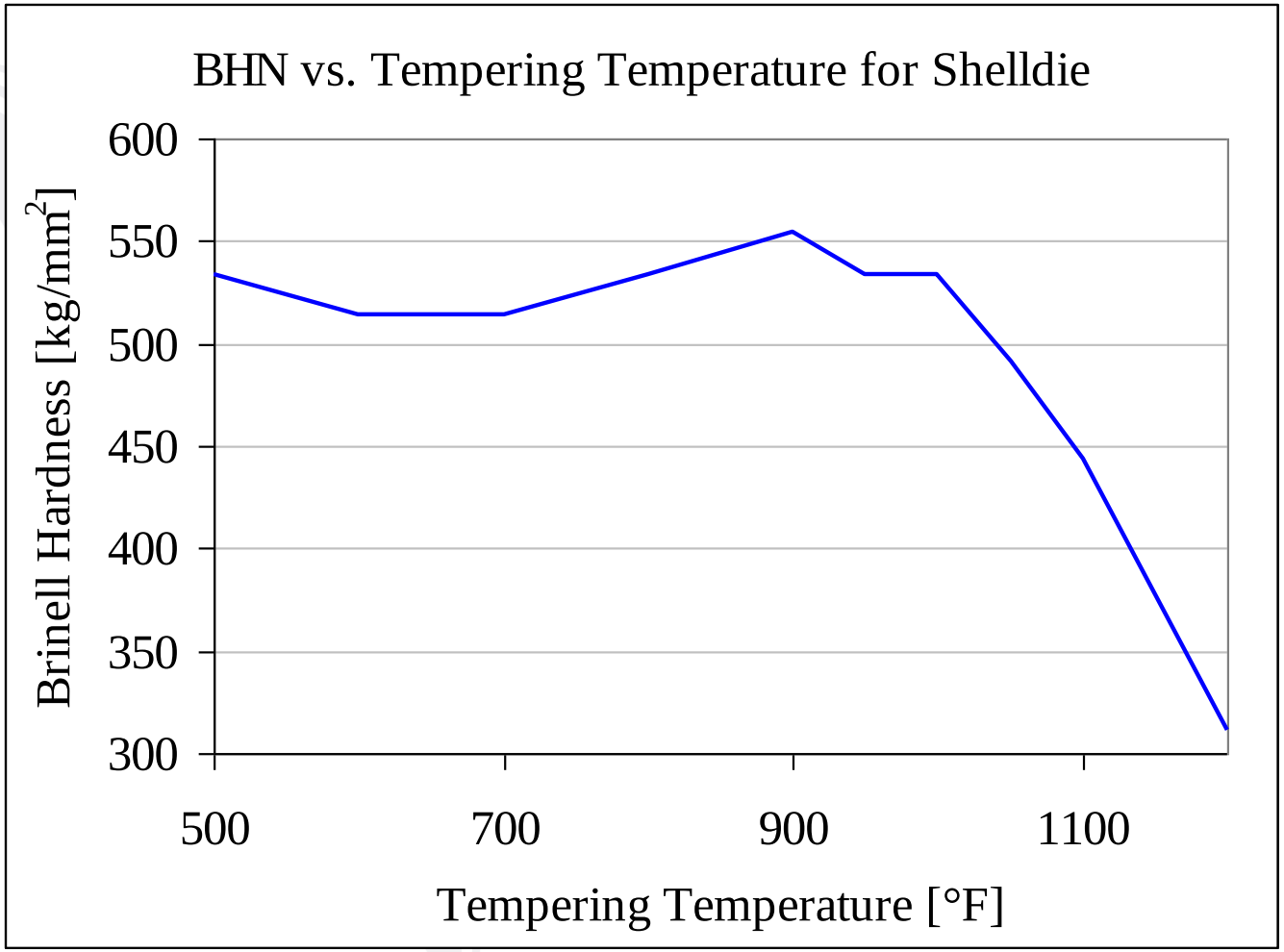

Furnace Survey Conclusions

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- Temperature distributions in both loaded and unloaded furnaces are acceptable
- Air temperatures near the floor are cooler in a loaded furnace, however part temperatures are still relatively even
- The firing lanes are typically hotter than the loading zone volume
- Parts must be loaded completely within the loading zone

AutoStack Software

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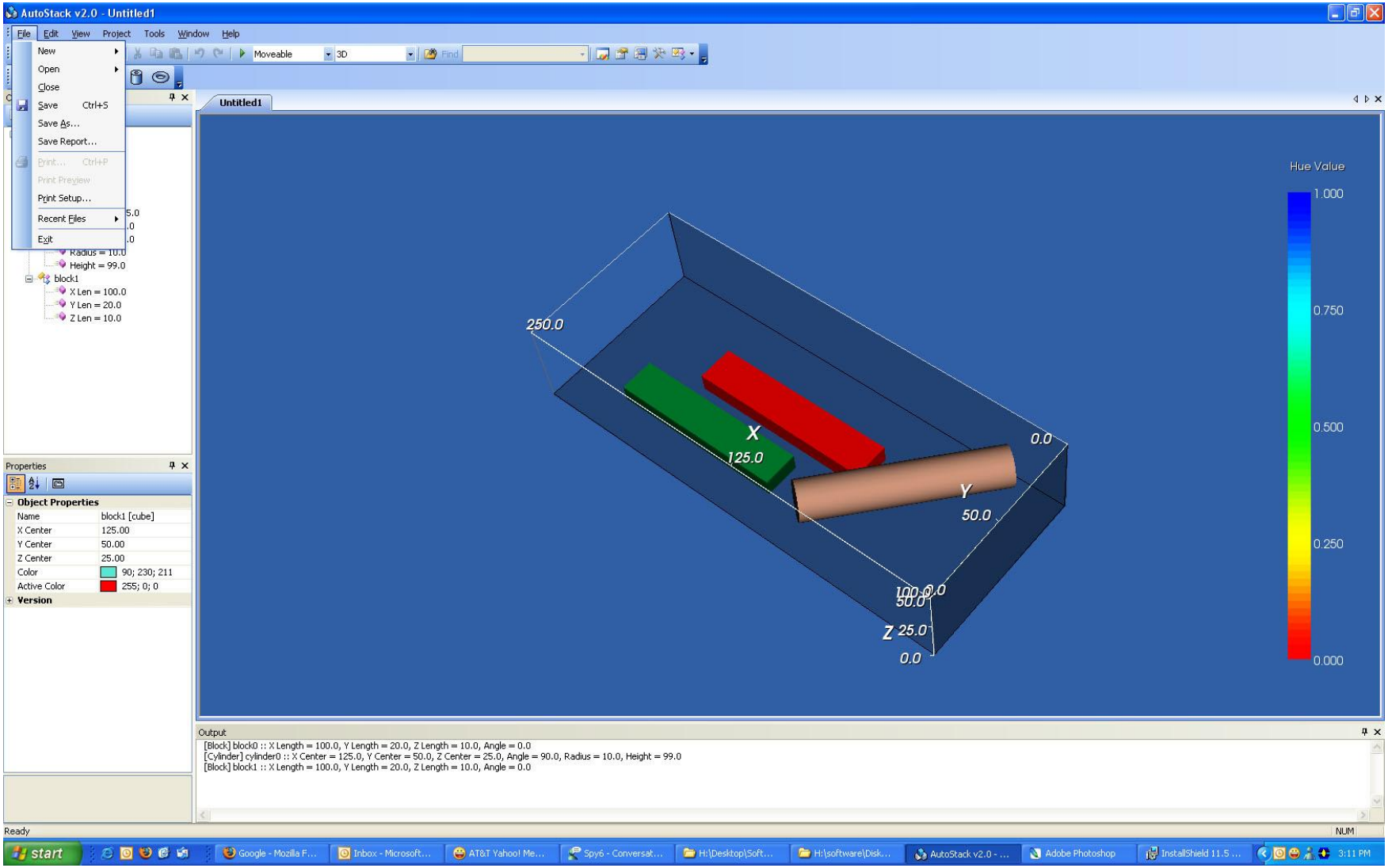

Development Tools

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- C++
- MFC (Microsoft Foundation Classes)
- VTK (Visualization Toolkit, www.vtk.org)
- OpenGL (www.opengl.org)
- Codejock Xtreme Toolkit (www.codejock.com)
- Microsoft Visual Studio 2003
- Collision Detection Engine by University of North Carolina (www.unc.edu)
- VTK Routines by Cineca, Italy (www.cineca.it)

Achievements

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- ≈8000 lines of code
- Commercial grade application
- Fast scene rendering with per pixel lighting, normal mapping, specular highlighting
- State of the art collision detection
- HTML rendering engine
- Minimal system requirements
- Platform independence

Conclusions

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- Furnace Survey
  - Furnace #30 was fine
  - Only tested 1 of several furnaces
  - Only tested 1 stacking set-up
- Software's benefits and limitations
  - Represents actual stacking in 3-D
  - Replaces old hand-written files
  - Currently, only able to create simple shapes
- Groundwork for final solution has been laid

Future IPROs

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- Portable Handset Display
  - Palm or Tablet PC
  - Run stacking software quickly and easily
  - Real-time capabilities
- Enhance Shape Data Base
  - Predefine all components
  - Interface with existing database
  - Improve current collision detection

Future IPROS

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- Furnace Testing
  - Survey more furnaces (empty and loaded)
  - Evaluate different stacking sequences
  - Change location of control thermocouples
- Statistical Analysis of Temp. Ranges
  - Limit temp. ranges for different grades
  - Construct temper curves
- Bar Coding Blocks
  - Withstand harsh environments

Acknowledgments

A. Finkl & Sons

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Question & Answer