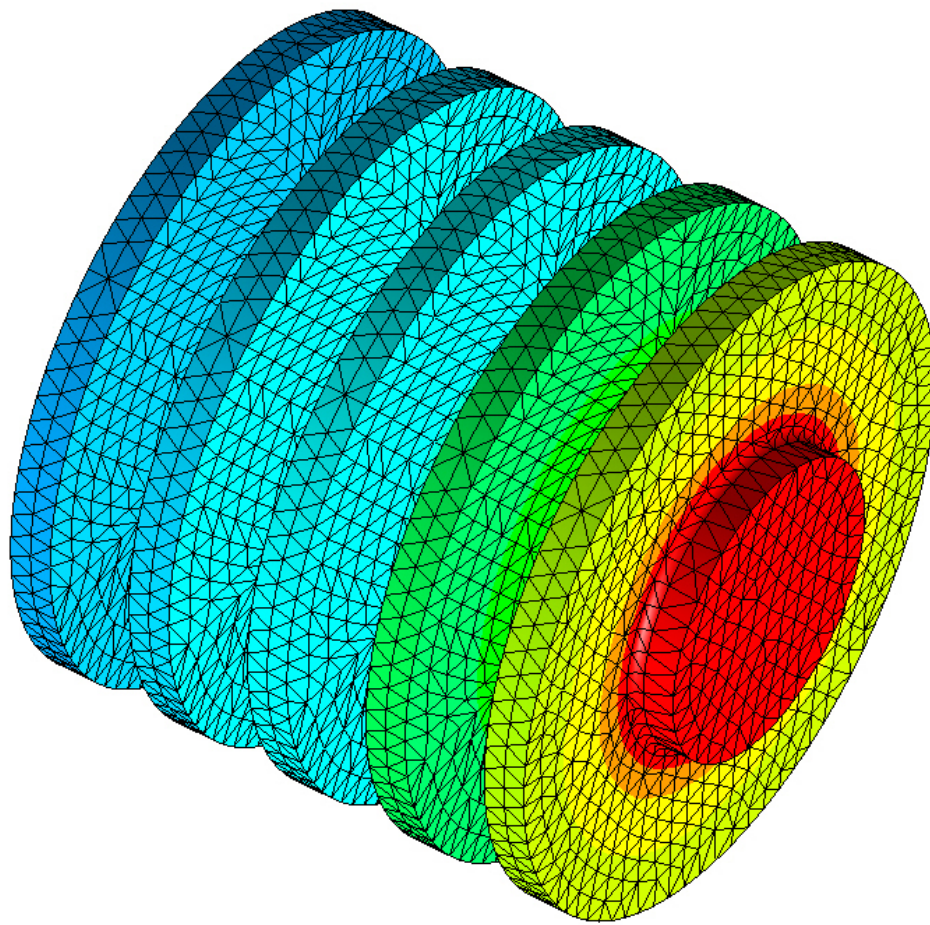


# Thermal Analysis

with SOLIDWORKS® Simulation 2015  
and Flow Simulation 2015



Paul M. Kurowski



Design Generator Inc.

CERTIFIED  
Solution  
Partner

 SOLIDWORKS

  
SDC  
PUBLICATIONS

**Better Textbooks. Lower Prices.**  
[www.SDCpublications.com](http://www.SDCpublications.com)

Visit the following websites to learn more about this book:



[amazon.com](https://www.amazon.com)

[Google books](https://books.google.com)

[BARNES & NOBLE](https://www.barnesandnoble.com)

# Table of contents

---

<b>About the Author</b>	<b>i</b>
<b>Acknowledgements</b>	<b>i</b>
<b>Table of contents</b>	<b>ii</b>
<b>Before You Start</b>	<b>1</b>
Notes on hands-on exercises and functionality of Simulation	
Prerequisites	
Selected terminology	
<b>1: Introduction</b>	<b>5</b>
Heat transfer by conduction	
Heat transfer by convection	
Heat transfer by radiation	
Thermal boundary conditions	
Analogies between thermal and structural analysis	
Thermal elements: solids and shells	
Scalar and vector entities, presenting results	
Steady state thermal analysis	
Transient thermal analysis	
Linear thermal analysis	
Nonlinear thermal analysis	
<b>2: Hollow plate</b>	<b>21</b>
Heat transfer by conduction	
Heat transfer by convection	
Different ways of presenting results of thermal analysis	
Convergence analysis in thermal problems	
Solid elements in heat transfer problems	
Shell elements in heat transfer problems	
<b>3: L bracket</b>	<b>33</b>
Heat transfer by conduction	
Use of 2D models	
Singularities in thermal problems	

<b>4: Thermal analysis of a round bar</b>	<b>39</b>
Heat transfer by conduction	
Thermal conductivity	
Heat transfer by convection	
Convection boundary conditions	
Thermal resistance	
Prescribed temperature boundary conditions	
Heat power	
Heat flux	
<b>5: Floor heating duct – part 1</b>	<b>55</b>
Heat transfer by conduction	
Prescribed temperature boundary conditions	
Heat power	
Heat flux	
Heat flux singularities	
Analogies between structural and thermal analysis	
<b>6: Floor heating duct – part 2</b>	<b>73</b>
Heat transfer by convection	
Free and forced convection	
Convection coefficient	
Ambient (bulk) temperature	
<b>7: Hot plate</b>	<b>81</b>
Transient thermal analysis	
Conductive heat transfer	
Convective heat transfer	
Heat power	
Thermostat	
Thermal inertia	
<b>8: Thermal and thermal stress analysis of a coffee mug</b>	<b>97</b>
Transient thermal analysis	
Thermal stress analysis	
Thermal symmetry boundary conditions	
Structural symmetry boundary conditions	
Use of soft springs	

<b>9: Thermal and thermal buckling analysis of a link</b>	<b>109</b>
Buckling caused by thermal effects	
Interpretation of Buckling Load Factor	
<b>10: Thermal analysis of a heat sink</b>	<b>115</b>
Analysis of an assembly	
Thermal contact conditions	
Steady state thermal analysis	
Transient thermal analysis	
Thermal resistance layer	
Thermal symmetry boundary conditions	
<b>11: Radiative power of a black body</b>	<b>129</b>
Heat transfer by radiation	
Emissivity	
Black body	
Radiating heat out to space	
Transient thermal analysis	
Heat power	
Heat energy	
<b>12: Radiation of a hemisphere</b>	<b>141</b>
Heat transfer by radiation	
Emissivity	
Radiating heat out to space	
View factors	
Heat power	
<b>13: Radiation between two bodies</b>	<b>147</b>
Heat transfer by radiation	
Emissivity	
Radiating heat out to space	
View factors	
Heat power	
Closed system	
Open system	

<b>14: Heat transfer with internal fluid flow</b>	<b>160</b>
Introduction to Flow Simulation	
Using Flow Simulation for finding convection coefficients in internal fluid flow	
Interfacing between Flow Simulation and Thermal analysis	
Interfacing between Flow Simulation and structural (Static) analysis	
<b>15: Heat transfer with external fluid flow</b>	<b>207</b>
Using Flow Simulation for finding convection coefficients in external fluid flow	
Interfacing between Flow Simulation and Thermal analysis	
<b>16: Radiative Heat Transfer</b>	<b>221</b>
Radiative heat transfer problem solvable with Thermal Study in SOLIDWORKS Simulation and with Flow Simulation	
<b>17: NAFEMS Benchmarks</b>	<b>239</b>
Importance of benchmarks	
One dimensional heat transfer with radiation	
One dimensional transient heat transfer	
Two dimensional heat transfer with convection	
<b>18: Summary and miscellaneous topics</b>	<b>255</b>
Summary of exercises in chapters 1-13	
Nonlinear transient problems	
Advanced options of thermal study	
Closing remarks	
<b>19: Glossary of terms</b>	<b>273</b>
<b>20: References</b>	<b>275</b>
<b>21: List of exercises</b>	<b>277</b>