Contents

1 The Construction and Operation of Modern Warehouses 1
1.1 Energetically Favorable Warehouse Location and Size 1
1.2 Methods for Effective Use of Warehouse Area and Volume in Order to Reduce Energy Intensity 3
1.3 Minimizing Heat Exchange with the Environment During Logistics Operations—Reloading Bays 10
1.4 Automatic Rack Stackers 12
1.5 Means of Carrying Loads 13
1.6 Warehousing Program—Reducing the Energy Intensity of Processes 14
1.7 Automatic Identification in Warehouse Logistics Systems as a Mean to Reduce the Energy Intensity of Logistics Processes 16
1.8 Insulation Systems for Storage Rooms 19

2 Indicators and Measures of Energy Efficiency the Warehouse 23

3 Warehouse Energy Balance 29
3.1 Heat Flux from the Permeation Through Construction Barriers . . . 30
3.2 Heat Flux Brought to the Premises Through Ventilation 32
3.3 Operating Heat Fluxes 33
3.4 Other Sources of Heat 34

4 Improvement Concepts in Terms of Energy Savings 37
4.1 Energy-Efficient Means of Cargo Handling 37
4.2 Energy-Efficient Lighting Systems in Warehouses 47
4.2.1 Incandescent Lamps 47
4.2.2 Halogen Lamps. 47
4.2.3 Fluorescent Lamps 48
4.2.4 High-Intensity Discharge Lamps 48
4.2.5 LED Systems 48
4.2.6 Comparison of Light Sources 48

4.3 Innovative Systems to Support Picking Processes and Reduce Energy Consumption 51
4.3.1 Pick-by-Voice 51
4.3.2 Pick-by-Point 52
4.3.3 Pick-by-Light 52
4.3.4 Pick-o-Light 53
4.3.5 Pick-by-Frame 54
4.3.6 Pick-Radar 55
4.3.7 Pick&Go 55
4.4 Energy-Efficient Air Conditioning and Heating Systems 56
4.5 Heat Pumps and Solar Cells 59
4.5.1 Liquid Solar Collectors and Photovoltaic Cells 63

5 Conceptual Design of a Cold Room 71
5.1 Project Assumptions 71
5.2 Warehouse Size 71
5.3 The Calculation of Cycle Times of Transport and the Number of Devices 78
5.3.1 Forklifts 78
5.3.2 Rack Stackers 82
5.4 Number of Reloading Bays 85
5.5 Conveyors 87
5.6 Warehouse Lighting 88
5.7 Energy Balance of the Designed Warehouse 91
5.7.1 Heat Flux from the Permeation Through Construction Barriers 91
5.7.2 Operating Heat Fluxes 93
5.7.3 Heat Flux Supplied Through Ventilation 94
5.7.4 Total Heat Flux 95
5.7.5 Cooling Power of Chillers 95
5.8 Solar Photovoltaic Cells 97

Bibliography 101

http://www.springer.com/978-3-319-40897-2

The Energy Consumption in Refrigerated Warehouses

Zajac, P.

2016, XII, 102 p. 59 illus., 48 illus. in color., Hardcover
ISBN: 978-3-319-40897-2