



Politechnika Świętokrzyska

WYDZIAŁ BUDOWNICTWA I ARCHITEKTURY

VADYM ABYZOV
JAGODA JURUS

KATERYNA PUSHKAROVA
MARYNA KOCHEVYKH



MATERIALS SCIENCE FOR DESIGNERS OF ARCHITECTURAL ENVIRONMENT

Edited by Vadym Abyzov, Kateryna Pushkarova



MONOGRAFIA

ARCHITEKTURA 13



Politechnika Świętokrzyska
WYDZIAŁ BUDOWNICTWA I ARCHITEKTURY

VADYM ABYZOV
JAGODA JURUS

KATERYNA PUSHKAROVA
MARYNA KOCHEVYKH

MATERIALS SCIENCE FOR DESIGNERS OF ARCHITECTURAL ENVIRONMENT

Edited by Vadym Abyzov, Kateryna Pushkarova

MONOGRAFIA

ARCHITEKTURA 13

Kielce 2020

Scientific editor series \ Redaktor Naukowy serii
ARCHITECTURE AND URBAN DESIGN \ ARCHITEKTURA I URBANISTYKA
dr hab. inż. arch. Lucjan KAMIONKA, prof. PŚk

Reviewers \ Recenzenci:
prof. dr hab. inż. arch. Bohdan CHERKES
dr hab. inż. Marek J. CIAK, prof. UWM

Technical editor \ Redakcja i skład
Irena PRZEORSKA-IMIOŁEK

Cover designer \ Projekt okładki
Oksana CHUIEVA

© Copyright by Politechnika Świętokrzyska, Kielce 2020

ISBN 978-83-65719-72-0

Wydawnictwo Politechniki Świętokrzyskiej
25-314 Kielce, al. Tysiąclecia Państwa Polskiego 7
tel./fax 41 34 24 581
e-mail: wydawca@tu.kielce.pl
www.wydawnictwo.tu.kielce.pl

CONTENTS

Introduction	7
CHAPTER 1. The role and position of building materials in architecture and design	9
1.1. Building materials in the history of architecture and design	9
1.2. Evolution of building materials in the context of the history of architecture and building systems	14
References	25
CHAPTER 2. Classification and methods of standardization of building materials	26
2.1. General classification of building materials	26
2.2. Modern understanding of the structure and composition of building materials	28
2.3. The principles of standardization of building materials (unification and typification)	31
References	33
CHAPTER 3. The basic properties of building materials	34
3.1. Physical properties	34
3.2. Mechanical properties	36
3.3. Operational (special) properties	38
3.4. Aesthetic properties	43
References	44
CHAPTER 4. Natural stone materials	45
4.1. Features of the formation and characteristics of major rocks	45
4.2. Natural stone products	61
4.3. Natural stone in the design of architectural environment	66
4.3.1. Landscaping	66
4.3.2. Exterior design	71
4.3.3. Interior design	77
4.4. General description of natural stone and stone products	80
References	81
CHAPTER 5. Ceramic materials and products	82
5.1. General information about ceramic materials. Classification and methods of decorating	82
5.2. Methods and types of decoration for ceramic materials	86
5.3. Ceramic products	88
5.4. Ceramic materials and products in the design of architectural environment	99
5.4.1. Landscaping	99
5.4.2. Exterior design	104
5.4.3. Interior design	111
5.5. The generalized characterization of ceramic materials	118
References	119
CHAPTER 6. Glass and other materials of mineral melts	121
6.1. Classification of mineral melts materials. Ways of processing and decoration of glass	123
6.2. The main types of construction and decorative glass. Special purpose products from mineral melts	126
6.3. Materials and products of glass in the design of architectural environment	145
6.3.1. Landscaping	145
6.3.2. Exterior design	151
6.3.3. Interior design	160
6.4. General characteristic of glass and products based on it	169
References	170

CHAPTER 7. Metal materials	172
7.1. General characteristics of metals. Classification of cast irons, carbon steels and non-ferrous metals and alloys	173
7.2. Main properties of metals. Types of decorating of metal materials	175
7.3. Products from steel and non-ferrous metals	178
7.4. Metal products and constructions in the design of architectural environment	184
7.4.1. Landscaping	185
7.4.2. Exterior design	193
7.4.3. Interior design	201
7.5. General characteristic of metallic materials and products	207
References	208
CHAPTER 8. Mineral (inorganic) binders, mortars and concretes	209
8.1. Classification and general characteristics of mineral (inorganic) binders	213
8.2. Mortars and dry mixes. Concrete: composition, structure, properties	219
8.3. Reinforced concrete products and structures	240
8.4. Concrete and mortar mixtures in the design of architectural environment	250
8.4.1. Landscaping	250
8.4.2. Exterior design	257
8.4.3. Interior design	263
8.5. Generalized characteristic of products on the basis of binders, mortars and concrete	267
References	268
CHAPTER 9. Materials and products made of wood	270
9.1. General informations	270
9.2. Structure and basic properties of wood	273
9.2.1. Wood structure and classification	273
9.2.2. Basic properties of wood	276
9.3. Methods of wood decoration	279
9.4. The main types of materials from wood waste and its recycling	285
9.5. Wooden products in the environment design	297
9.5.1. Landscaping	297
9.5.2. Exterior design	302
9.5.3. Interior design	311
9.6. Generalized characteristic of wood-based products	322
References	323
CHAPTER 10. Polymer materials	325
10.1. Classification and general characteristics of polymer substances and materials on their basis	328
10.2. Basic properties and features of polymeric production	333
10.3. Modern polymer materials and products	336
10.4. Polymer products and structures in the design of architectural environment	345
10.4.1. Landscaping	345
10.4.2. Exterior design	349
10.4.3. Interior design	353
10.5. Generalized characteristic of products based on polymeric materials	367
References	368
CHAPTER 11. Innovative materials and products	369
11.1. Recycled materials	371
11.2. "Old-new" natural materials	392
11.3. Nanomaterials	401
References	409

CHAPTER 12. Building materials used in the conservation, renovation, reconstruction and restoration of historic buildings	411
12.1. Materials used in the conservation and renovation of monuments	411
12.1.1. Conservation and renovation of historic wooden buildings	411
12.1.2. Conservation and renovation of historic stone buildings	419
12.1.3. Conservation and renovation of historic ceramic buildings	422
12.2. Materials used in reconstruction and restoration	428
11.2.1. Reconstruction and restoration of historic wooden buildings	428
11.2.2. Reconstruction and restoration of historic stone objects	434
11.2.3. Reconstruction and restoration of architectural detail	434
References	439
CHAPTER 13. New trends and features of building materials usage with regard to the development of the main directions of improving the architectural and building systems	440
13.1. Prefabricated large-panel systems	440
13.2. Prefabricated framework systems	448
13.3. Modular cell systems	455
13.4. Block systems	460
13.5. Monolithic systems	464
References	470
Biographies of the authors	473