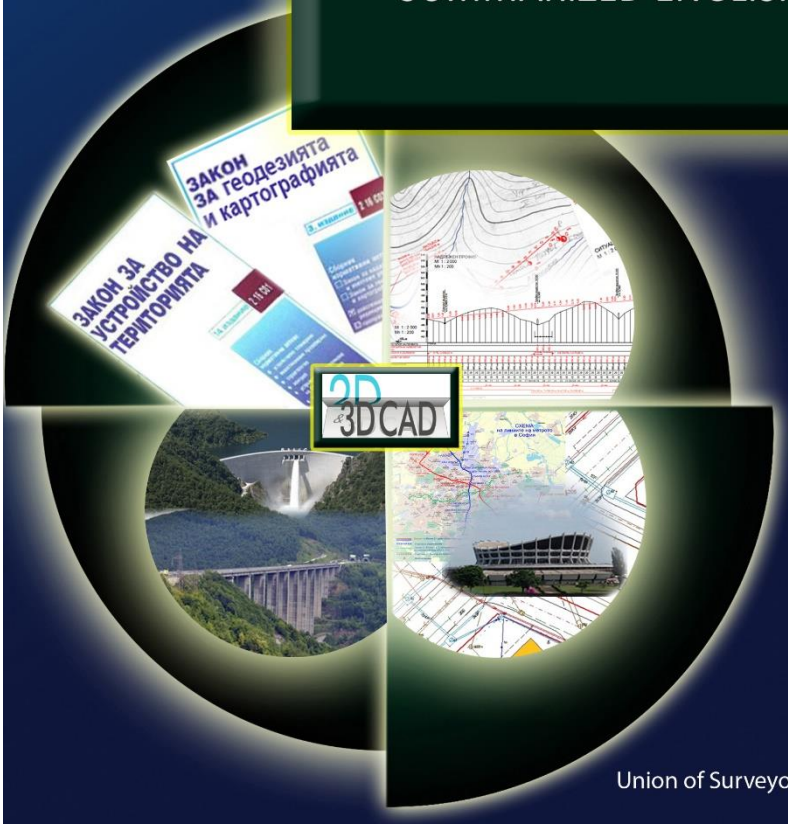
Corr. Mem. Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV

APPLIED GEODESY

Part 1
ENGINEERING GEODESY

SUMMARIZED ENGLISH PRESENTATION



Union of Surveyors and Land Managers in Bulgaria
Sofia, 2023

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APPLED GEODESY

Part 1

ENGINEERING GEODESY

SUMMARIZED ENGLISH PRESENTATION

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2017

PREFACE TO THE SUMMARIZED ENGLISH PRESENTATION

This book is a summarized presentation and covers the English part of the complex monograph Applied Geodesy - Part 1. Engineering Geodesy. In addition, some explanations are added at the end, as well as a presentation part of the monograph, reviews, ratings and reviews. Due to the unconventionally huge volume of the complex monograph (2870 computer pages), the number of books – 5, type, contents and exposition, language, etc. the reader may have difficulties with the overall view and perception of what is presented in the monograph. This is avoided with the proposed presentation. Along with this, the presentation will, to a certain extent, make the complex monograph more accessible to interested English speakers. Thus, it appears as an essential complementary and facilitating element of the complex monograph. It contributes to visualizing the image, conceptions of the essence, ideas, understandings and the type and manner of presentation of these interdisciplinary fields and areas of science, education and practice of the authors. Moreover, the complete translation of the complex monograph from Bulgarian to English would again require enormous efforts, work and time. In the presentation, due to its specificity and character, there are inevitably semantic repetitions, repetition of figures and others. We hope that they will be well perceived by the readers. We also hope that the summarized presentation of the complex monograph will contribute, to a certain extent, to its more successful perception and use.

Sofia, 11/03/2023. The authors

CONTENTS OF THE ENGLISH PRESENTATION TO COMPLEX MONOGRAPH

1. GENERAL INTRODUCTION TO COMPLEX MONOGRAPH

A completed generalizing, interdisciplinary, peer-reviewed work entitled Applied Geodesy - Part 1. Engineering Geodesy (in Bulgarian, nearly 9 years in the making) has been published. It consists of 5 books (complex monograph). Each of the books practically represents (a system of monographs). There is a short introduction in English as well (title page, abstract, preface, table of contents, authors' biographies). This is a summary presentation of the English part of the complex monograph.

A systematization, summary and complex presentation of Applied Geodesy, and of Part 1. Engineering Geodesy was done, of it, together with space and geospatial technologies and their application mainly in construction, architecture, territorial organization and the role and place of Engineering Geodesy in their implementation. For the first time, this complex field and activity are presented together, and Engineering Geodesy as its permanent element. Furthermore, the exposition of the text in the books follows the course of the traditional stages of the organization of the territory (physical planning), the construction (the idea, the preliminary studies, the design, the implementation of construction) and exploitation of the engineering objects and their complexes.

The work is formed as a united, original digital whole (a complex digital monograph, 2870 computer pages) with unified table of contents, exposition, numbering and other new elements. There are also claims for the introduction of new categories and concepts (complex monograph, systems of monographs, numbering system), systematization, summarization and complex presentation of parts of science and practice, and others. The work has no analogue in literature.

The authors

2. JOINT PRESENTATION AND EVALUATION OF APPLIED GEODESY AND ENGINEERING GEODESY

The essence and content of Applied and Engineering Geodesy are presented according to the views of the authors.

The insertion of the part about the nature and presentation of Applied and Engineering Geodesy in book 1 of Part 1. Engineering Geodesy is determined by the need for the reader to be able to orientate and perceive the hierarchy in the presentation of the problems of Applied and Engineering Geodesy, since at this stage the emphasis is placed on the issue of Engineering Geodesy, not Applied Geodesy as a whole. This situation will be avoided by simultaneous presentation of the three sections of Applied Geodesy. Then the title page, instead of the present one of Book 1, will be of Applied Geodesy.

Corr. Mem. Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV

APPLIED GEODESY

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2017

1.1. Preface to Applied geodesy

Applied geodesy encompasses the versatile application of the science of Geodesy.

In world literature, unfortunately, there is no systematization, summarization, structuring and presentation of the problems of Applied Geodesy (theory and practice) as a whole, as a separate area of the science of Geodesy. The present monographic work is intended to solve these problems, and in particular those of Engineering Surveying.

The application of Geodesy – Applied Geodesy, is distinguished and defined here by the authors in three aspects (directions, areas): *engineering* – 1. **Engineering Surveying**, *natural scientific* – 2. **Application of Geodesy in Earth Sciences,** and *other applications* – 3. **Non-engineering and natural-scientific aspects of application of Geodesy**. The first aspect is treated most multilaterally, it is most widely applied and is with enormous reference literature.

The presentation of the content of matter in these three aspects is foreseen by the authors to be, in accordance with the aspects, in three separate **expositions – parts**.

Part 1. Engineering Surveying issued in the form of three separate books:

Book 1 **"Basics, systems and technologies in Engineering Surveying"**;

Book 2 **"Design and implementation of physical and general plans"**;

Book 3 **"Construction of linear objects, buildings, facilities, installation of technological equipment. Plans of the built complex objects"**.

Book 2 is published: in digital form, an E-book, by [http://Billio.bg] at the end of 2016, and in an analogue form – by the Avangard Publ. House, in the beginning of 2017 in a volume of 330 pp. It is distributed in the bookstores of UACEG, UMG, the SEK and Blestyasht Fakel Publ. Houses.

Book 1 is the present edition (in digital and analogue form) and Book 3 is prepared for publication also in 2017.

The books are an edition of the Union of Surveyors and Land Managers in Bulgaria.

Parts 2 and 3 are still in a project but it is intended to preserve the manner of preparation and form as those of the exposition of the first part.

The text and figures related to the presentation of Applied Geodesy and Engineering Surveying are given here at the beginning of Book 1, and although they are divided, the exposition, comments and references are treated united.

The authors

1.2. Contents of applied geodesy

ENGINEERING GEODESY

Corr. Mem. Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV

APPLIED GEODESY

Part 1

ENGINEERING GEODESY

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2017

1.3. Preface to Engineering Geodesy

The first part of the authors' project is **1. Engineering Surveying/ Geodesy**.

It is noted in the preface of 01 that **1. Engineering Surveying** consists of 3 separate books: Book 1 **"Basics, systems and technologies in Engineering Surveying"**; Book 2 **"Design and implementation of physical and general plans"** and Book 3 **"Construction of linear objects, buildings, facilities, installation of technological equipment. Plans of the built complex objects"**. Book 2 has been published and Books 1 and 3 are being prepared for publication.

The three books are separate but organically integrated in a digital entity – **1. Engineering Surveying**. The structure, numbering of titles, figures, tables, references, etc., of the three books are an indivisible part – an element of 1. Engineering Surveying. This determines the possibility of offering the three books further in the form of a unified digital edition as **1. Engineering Surveying**. In fact, the book was initially planned in this way.

It has to be clearly mentioned here that the **structure, contents and exposition** of Book **1. Engineering Surveying** are original, reflect the views and positions of the authors and do not correspond to other works on Engineering Surveying in Bulgaria and abroad. To a great extent it includes results of theoretical formulations, their research and experience from the applied activities in the various areas related to the design, implementation and operation of engineering objects or their complexes. Undoubtedly, this has a positive side for illustrating the exposition but there is also a negative aspect, which we hope to be not significant. At the same time the presentation is in compliance with **Bulgarian legislation** and its alignment with that of the European Union.

1.4. Contents of engineering geodesy

02. ENGINEERING GEODESY
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02.2. Tasks
02.3. Scope
02.4. Structure and contents
02.5. Penetration of engineering surveying
02.6. Role of engineering surveying
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3. POSTERS OF THE BOOKS FROM THE COMPLEX MONOGRAPH

BAS - SRTI
UNION OF SURVEYORS
AND LAND MANAGERS IN BULGARIA

APPLIED AND ENGINEERING GEODESY

The project „APPLIED GEODESY" of the authors G. Milev and I. Milev consists of three parts:

1. Engineering surveying,
2. Application of Geodesy in Earth Sciences,
3. Other (non-engineering and natural scientific) aspects of Geodesy.

The three parts together treat the versatile application of Geodesy.

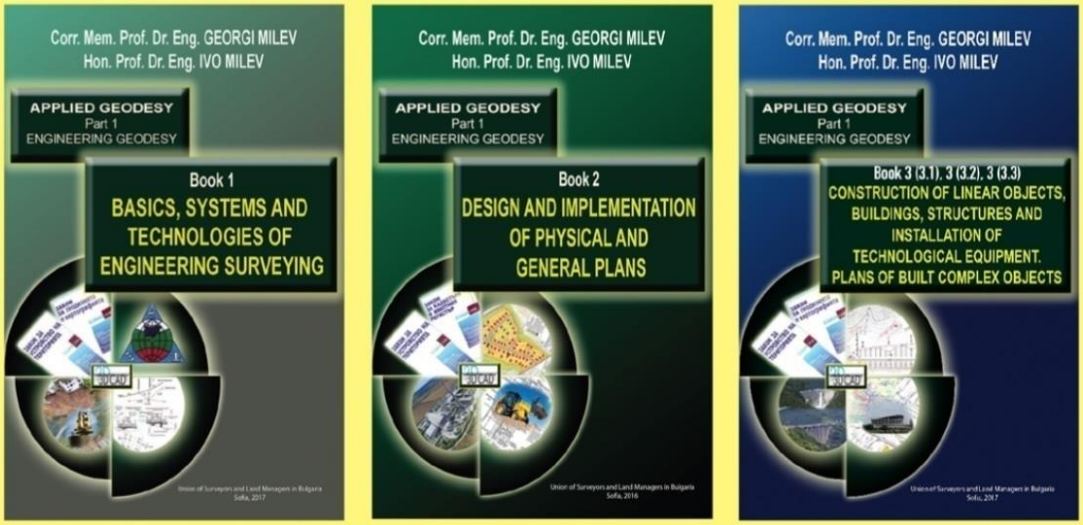
Part 1. ENGINEERING SURVEYING consists of five books:

1. Basics, systems and technologies in Engineering Surveying – 496 p.,2017y.

2. Design and implementation of physical and general plans – 325 p.,2017y.

3. Construction of linear objects, buildings, facilities, installation of technological equipment. Plans of the built complex objects – due to the large volume, over 1500 pages, it is separated into three books – 3(3.1 – 524 p.,2020y.), 3(3.2 – 530 p.) and 3(3.3 – 468 p.),2022y..

Every one of the five books has a short presentation in English language (cover page, annotation, foreword, contents, biographies of the authors).



The books of Part 1 are formed as a complete whole. They contain uniform numbering of text, formulas, tables and black & white, and colour figures, and are in an A4 format. They are published in Avangard Publishing House and can be purchased in the bookstores of UACEG, UMG, SEK and Blestyasht Fakel.

The books were uploaded in digital form on the server of the electronic library Biblio.bg at http://biblio.bg in .pdf file format. General information and the beginning of the books to page 22 are immediately available by searching „Georgi Milev" or at https://tinyurl.com/wmbqz5c; https://tinyurl.com/ums3dfv. They are uploaded on the servers of ISRT-BAS (http://space.bas.bg/bg/publishing_activity/books_and_journals.html); DGK (http://www.dgk.badw.de/meldungen.html), Germany.

The books represent an original systematization, summary and axposition of this branch of science and practice in monographic form and are an edition of the Union. The authors have sponsored the books.

Fig. 1. Poster of the complex monograph

Fig. 2. The five books from the complex monographs on Engineering Geodesy

Annotation

Interdisciplinary problems related to the development of territories – development schemes, physical and general plans of a complex of objects – industrial enterprises, airports, etc., are presented along with the role of geodesy and the contribution of land surveyors to their realization. The major emphasis is laid on the technology of design and implementation of regulation plans, general plans and schemes and drafts for vertical planning. Moreover the problems are treated from an interdisciplinary point of view and in the context of the modern possibilities of: digital design, geospatial technologies, using of global navigation satellite systems, electronic systems for data measurement and processing, tracing and monitoring, geoinformation systems, use of modern digital cadastre and others. Along with this the exposition is based and reflects, insofar as possible, the huge current normative and subordinate basis – laws, rules, regulations, instructions, guidelines, etc., and it has become necessary in some cases to cite directly some major aspects of it. However this basis is dynamically developing and its actual state should be always accounted for. A number of real practical examples of physical planning of territories are also included. The long-year work and experience of the authors are also reflected.

Undoubtedly such a broad spectrum of issues cannot be exhaustively considered in all its aspects. A balance has been sought for in the structure of the book and exposition to present the main problems and the emphasis is put on the aspects related more directly to the activities of surveyors in the area of physical planning.

The book is intended primarily for surveyors. However, because of the interdisciplinary nature of the problems and the manner of exposition, it can be very useful for a broad circle of specialists – architects, engineers, lawyers and others working on the issues of physical planning. The benefits may be for the lecturers and all studying these problems, workers in the municipalities and courts, and in the design and construction in this area, owners of land estates and many others.

The authors

REVIEWERS:

1. Corr. Mem. Prof. D.Sc. Arch. Atanas Kovachev, Assoc. Prof. Dr. Enz. V. Kotseva
2. Prof. Dr. Eng. Ilinka Ivanova
3. Assoc. Prof. Dr. Eng. Todor Kostadinov

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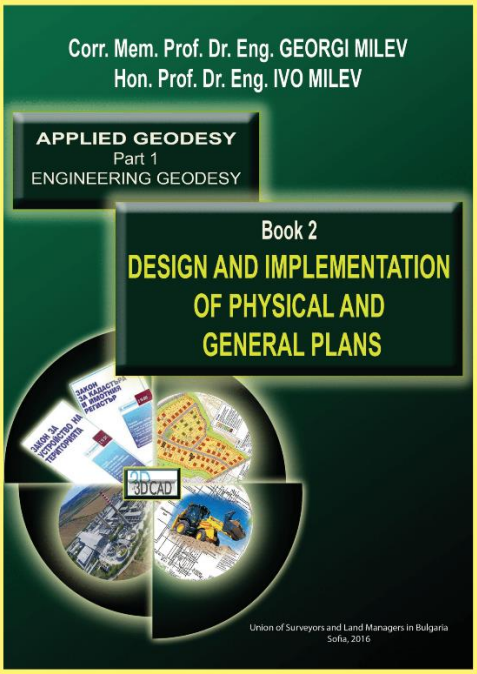
REVISED BOOK 2022



Editions of the book

The book "Design and implementation of structural and master plans "is part of the project "Applied Geodesy" of authors, consisting of three parts
1. Engineering Surveying
2. Application of Geodesy in Earth sciences
3. Non-engineering and natural science aspects of application of geodesy.

The three parts together treat the comprehensive application of Surveying. The book is actually Book 2 of part 1 "Engineering Surveying" which is ready for printing in form of three books:
1. Basics, systems and technologies of Engineering Surveying;
2. Design and implementation of structural and master plans;
3. Construction of linear objects buildings, structures, installation of technological equipment. Plans of built complex objects.

Book 2 is in a volume of 330 pages – text, formulas, tables and black – white and colorful figures in a format A4.

It is printed in Publishing house "Avangard" and can be bought in bookstores of the University of Architecture, Civil Engineering and Geodesy, SEC and Shining a torch. In digital form it is uploaded to the server:

http://biblio.bg

of the e-bookstore Biblio.bg in pdf format. The book is available up to page 22. The book is edition of the Union of Surveyors and Land Managers in Bulgaria. The other two books of part 1. Engineering Surveying will be printed and digitally accessible on the same server.

Fig. 3. Book 1 poster

Annotation

Book 1 treats the fundamentals of Engineering Surveying – the modern: investment process, normative base, geodetic basis (digital data, plans, maps and control networks), instruments, apparatuses and systems; reference and coordinate systems and surfaces, theoretical bases of geodetic measurement processing, algorithms and software, modern numerical geospatial technologies and their application in Engineering Surveying and related information systems. **The main issues of tracing** are presented: essence, elements, methods, technologies, accuracy, norms and cases; theoretical bases and practice in the control and determination of displacements and investigation of deformations of engineering objects, including in landslides.

In fact the exposition in this part of the book refers to **the theoretical and principal essentials, including systems, methods and technologies. Their specific application is further considered in the design and application of a complex of objects in Book 2 and in the construction of the individual particular objects in Book 3.**

The presentation has an original structure. It corresponds to the current normative regulations and the possibilities afforded by the modern digital devices, instruments, systems and technologies. The book reflects to a large extent the views, long-term research, teaching experience and participation in the construction and investigation of engineering objects, including with original spatial constructive solutions of the authors.

The book can be used by lecturers, students and practitioners in the field of Engineering Surveying and all those who work on the construction and exploitation of engineering objects and their complexes such as architects, civil engineers – constructors, and specialists in the transport and water sector, etc., designers, contractors performing organization and control of construction and installation of technological equipment. Undoubtedly, it is recommended to do this, if necessary, at the same time with the other two books of the authors.

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2. Prof. D.Sc. Eng. Georgi Valev
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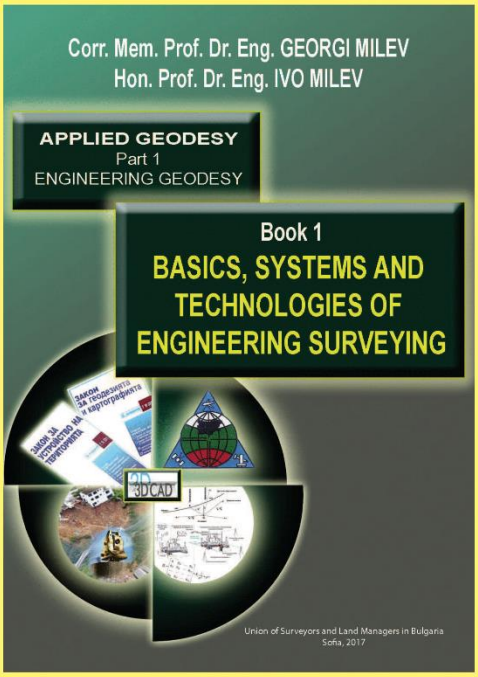

Editions of the book

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3. Construction of linear objects buildings, structures, installation of technological equipment. Plans of built complex objects.

Book 1 is in a volume of 498 pages – text, formulas, tables and black – white and colorful figures in a format A4.

It is printed in Publishing house "Avangard" and can be bought in bookstores of the University of Architecture, Civil Engineering and Geodesy, SEC and Shining a torch. In digital form it is uploaded to the server:

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Fig. 4. Book 2 poster

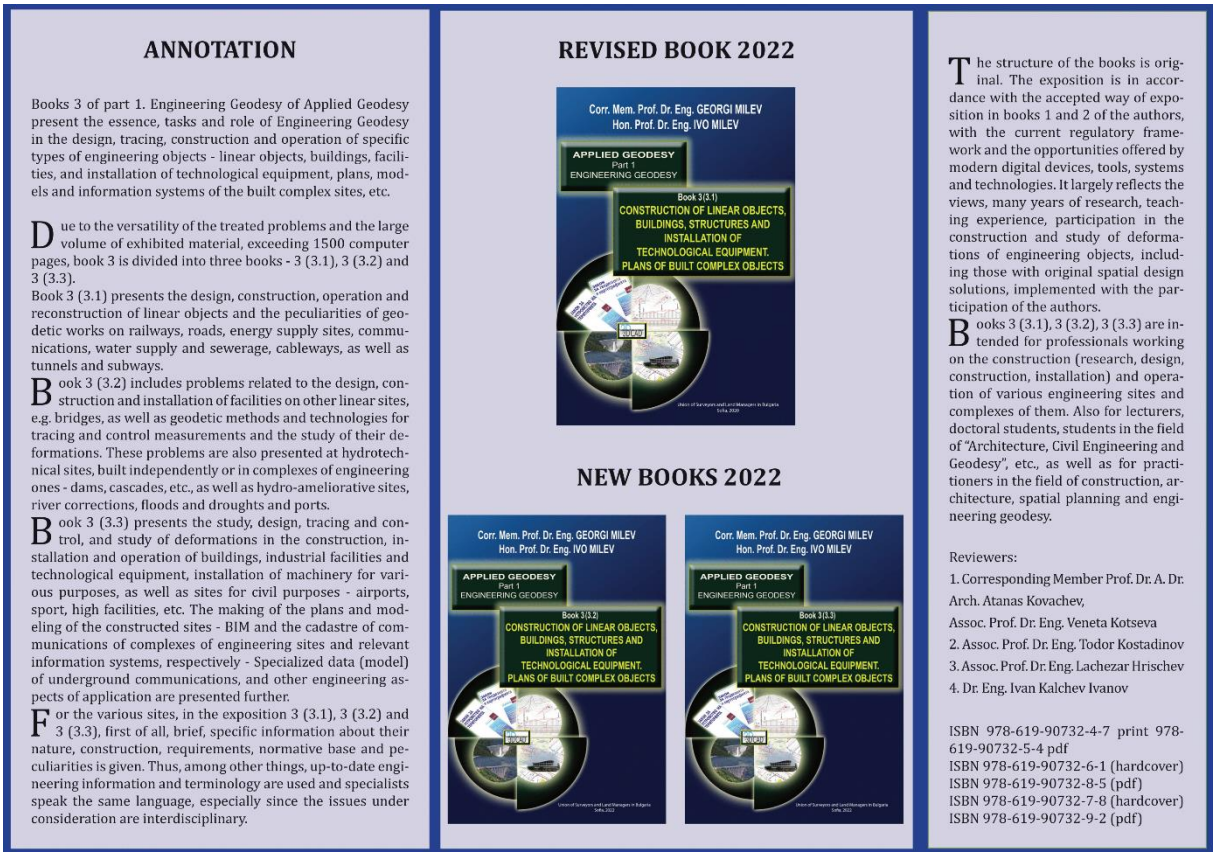
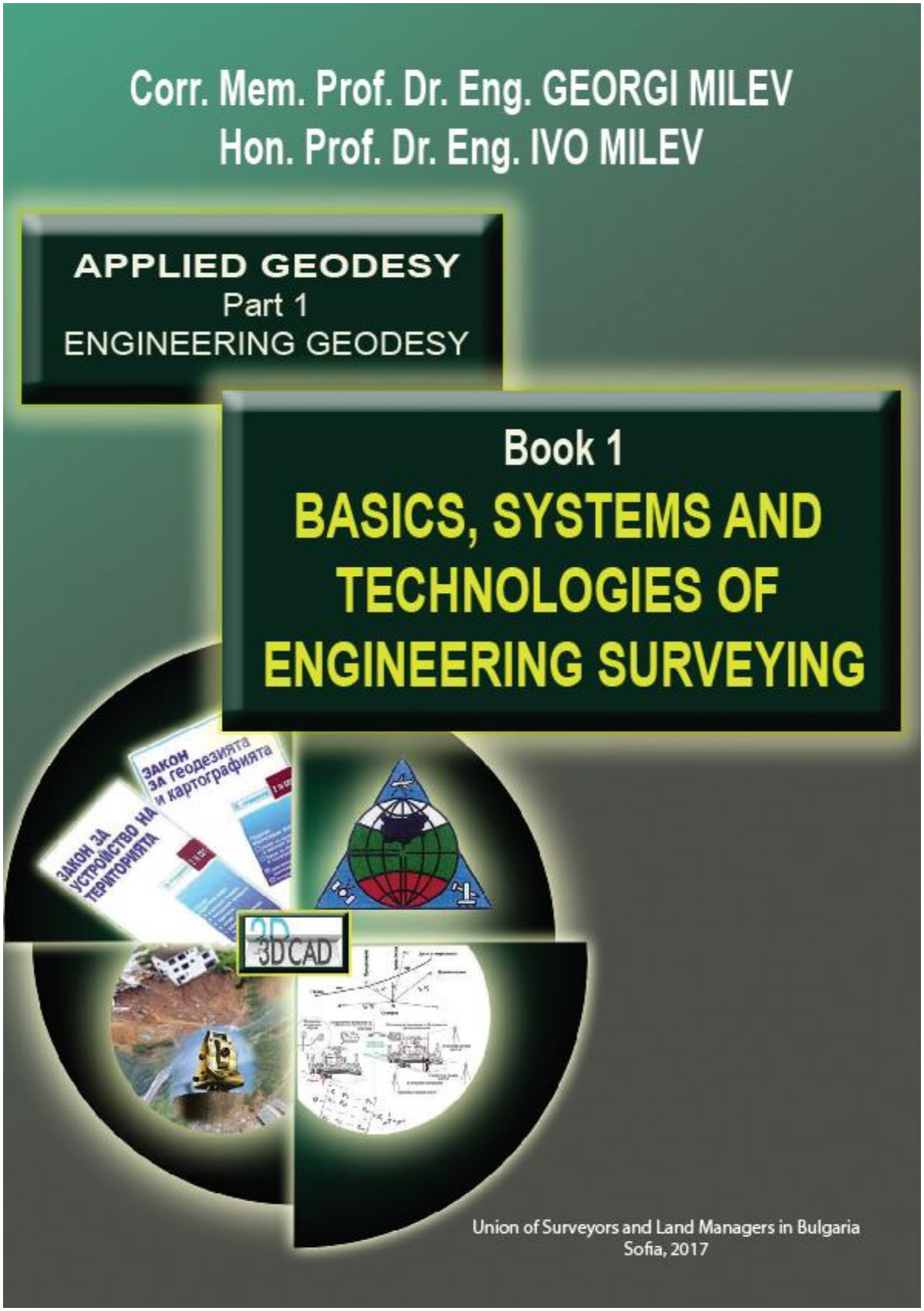


Fig. 5. General poster of books 3

3. BOOKS

3.1. BOOK 1



Corr. Mem. Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV

APPLIED GEODESY

Part 1

ENGINEERING SURVEYING

Book 1

BASICS, SYSTEMS AND TECHNOLOGIES OF ENGINEERING SURVEYING

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2017

Annotation

Book 1 treats the fundamentals of Engineering Surveying – the modern: investment process, normative base, geodetic basis (digital data, plans, maps and control networks), instruments, apparatuses and systems; reference and coordinate systems and surfaces, theoretical bases of geodetic measurement processing, algorithms and software, modern numerical geospatial technologies and their application in Engineering Surveying and related information systems. **The main issues of tracing** are presented: essence, elements, methods, technologies, accuracy, norms and cases; theoretical bases and practice in the control and determination of displacements and investigation of deformations of engineering objects, including in landslides.

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Preface

The book **"Basics, systems and technologies in Engineering Surveying"** is part of the **"Applied Geodesy"** project of the authors, consisting of three parts: **1. Engineering Surveying, 2. Natural scientific aspect of Geodesy application** and **3. Other applications of Geodesy**. The three together treat the versatile application of geodesy.

The book is actually the first part – Book 1 of Part 1. **Engineering Surveying**, which is prepared for press in the form of **3 books**, as Book 2 **"Design and implementation of physical and general plans"** – 330 pp., and has been already issued in digital [http://Billio.bg] and analogue form by the Union of Surveyors and Land Managers in Bulgaria and published by the Avangard Publishing House. As already noted in 02.7, Book 3 **"Construction of linear objects, buildings, facilities, installation of technological equipment. Plans of the built complex objects"** is also being prepared for printing.

The reason for releasing this part also as a separate book – Book 1, is the large volume of material on Engineering Surveying; the **specificity** and thematic differentiation of the problems; the **distinguishing, systematization, generalization and presentation** of modern achievements in this area, presented for the first time in the form of **systems, methods and technologies** (a basic inevitable element and prerequisite – theoretical and practical, for further realization in the particular engineering objects or their complexes); **the broad circle of professionals** working specifically in this area. Last but not least, this separate issuing will make the book much easily accessible for use. Its realization by means of the contemporary possibilities of digital publishing and application, including by mobile devices, is very favorable in this respect.

Along with this, however, there is a planned, immediate and inevitable connection between the treated herein matter and its concrete realization in the other two books of 1. Engineering Surveying. The application in construction is implied – the design, tracing and control during the building and installation of the different types of engineering objects and their complexes. This means that the three books represent a single organic entity – Engineering Surveying. Therefore, the whole numbering of titles, figures and tables, etc., is an inseparable part – an element of 1. Engineering Surveying. This also determines the inclusion of this book further on in a unified digital edition as 1. Engineering Surveying. Actually, as pointed out earlier, it has been included as an integral part of it.

In the reference literature dedicated to Engineering Surveying, in fact there are practically few specialized works devoted entirely to Engineering Surveying. However, there a lot more dedicated to the specific applications of Engineering Surveying. They have been reflected to a great extent, of course along with the current legal basis, in the proposed work.

The decimal numbering system is used in the book. Due to the large number of titles and their multiple stages, for the sake of clarity, simplification has been made here by introducing a double four-stage numbering as in our previously mentioned Book 2. It consists in the introduction of the conventional four-stage numbering with using, when necessary, a new additional four-stage numbering in the cases, when it has to be exceeded.

The authors acknowledge their gratitude to the Union of Surveyors and Land Managers in Bulgaria for the publication of the book under its auspices and for the cooperation and support during the preparation and realization of the book. We would like to thank also the reviewers: Corr. Mem. Prof. D.Sc. Arch. Atanas Kovachev, Assoc. Prof. Dr. Eng. Veneta Kotzeva, Prof. D.Sc. Georgi Valev and Assoc. Prof. Dr. Eng. Todor Kostadinov. We owe also gratitude to Prof. Dr. Eng. Borislav Marinov for the review and proposed amendments related to sections 1.3.3.4 and 1.3.3.6 of the books, to Prof. Dr. Plamen Malzhanski – for 1.3.3.10, to Prof. Dr. Eng. Keranka Vasileva – for 1.3.3.3 and 01 and 02, to Prof. D.Sc. Eng. Andrei Andreev – for 01 and 02.

Special thanks for the unreserved and active cooperation to Eng. Kristina Galabova for the preparation of the tables, formulas and most of the figures for press, as well as to Svetla Petrova and Eng. Ivanka Koleva for the elaboration of the cover of the book.

Sofia, July, 2017 The authors

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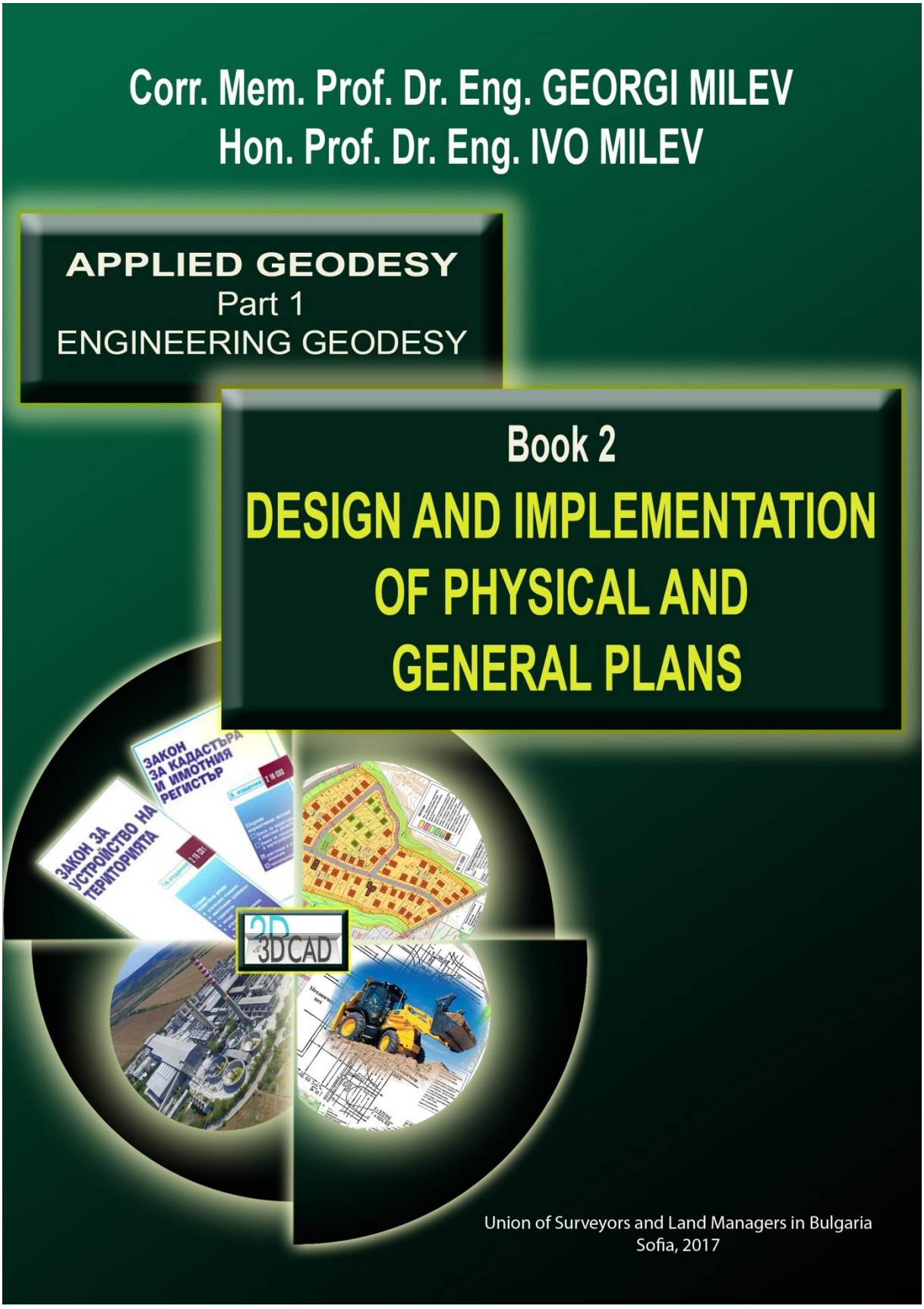
3.2. BOOK 2


Corr. Mem. Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV
APPLIED GEODESY
Part 1
ENGINEERING GEODESY
Book 2
DESIGN AND IMPLEMENTATION OF PHYSICAL AND GENERAL PLANS
ЗАКОН ЗА КАДАСТЪРА И ИМОТНИЯ РЕГИСТЪР
ЗАКОН ЗА УСТРОЙСТВО НА ТЕРИТОРИЯТА
2D
3DCAD
Union of Surveyors and Land Managers in Bulgaria
Sofia, 2017

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APPLIED GEODESY

Part 1

ENGINEERING GEODESY

Book 2

DESIGN AND IMPLEMENTATION OF PHYSICAL AND GENERAL PLANS

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2017, revised 2022

Annotation

Interdisciplinary problems related to the development of territories – development schemes, physical and general plans of a complex of objects – industrial enterprises, airports, etc., are presented along with the role of geodesy and the contribution of land surveyors to their realization. The major emphasis is laid on the technology of design and implementation of regulation plans, general plans and schemes and drafts for vertical planning. Moreover, the problems are treated from an interdisciplinary point of view and in the context of the modern possibilities of: digital design, geospatial technologies, using of global navigation satellite systems, electronic systems for data measurement and processing, tracing and monitoring, geoinformation systems, use of modern digital cadastre and others. Along with this the exposition is based and reflects, insofar as possible, the huge current normative and subordinate basis – laws, rules, regulations, instructions, guidelines, etc., and it has become necessary in some cases to cite directly some major aspects of it. However, this basis is dynamically developing and its actual state should be always accounted for. A number of real practical examples of physical planning of territories are also included. The long-year work and experience of the authors are also reflected.

Undoubtedly such a broad spectrum of issues cannot be exhaustively considered in all its aspects. A balance has been sought for in the structure of the book and exposition to present the main problems and the emphasis is put on the aspects related more directly to the activities of surveyors in the area of physical planning.

The book is intended primarily for surveyors. However, because of the interdisciplinary nature of the problems and the manner of exposition, it can be very useful for a broad circle of specialists – architects, engineers, lawyers and others working on the issues of physical planning. The benefits may be for the lecturers and all studying these problems, workers in the municipalities and courts, and in the design and construction in this area, owners of land estates and many others.

Sofia, 2017, revised 2022 The authors

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Preface

The book “Design and implementation of physical and general plans” is part of the **“Applied Geodesy”** project of the authors, consisting of two parts: 1. Engineering Geodesy and 2. Other Applications of Geodesy (not engineering applications of geodesy), both of them treating the comprehensive application of geodesy. The book is actually composite – the second part of 1. Engineering Geodesy is prepared for printing in the form of **3 books**.

The reason to issue this part as a separate digital book is on the one hand the specificity and thematic differentiation of the problems of physical planning and on the other hand – the tradition in its presentation and teaching till now, and most importantly – its wide application and broad circle of specialists working specifically and only in this area. And last but not least, its separate edition will make it more accessible for use. Its realization by means of the modern possibilities of digital publishing and use, including by mobile devices, is also very favorable.

Along with this, there is planned, direct and inevitable connection of the material treated herein with the other parts – books of Engineering Geodesy. These are the fundamentals of Engineering Geodesy, basics and principles related to tracing, investigation of deformations, cadastre and information systems, etc. Also – specific problems related to construction – design, tracing and monitoring during the construction and assembly of various types of engineering objects, built in (or mostly in) the settlements and industrial and other complexes. This determines the inclusion of this book further on in a unified digital edition as 1. Engineering Geodesy. Actually, as already mentioned, it has been originally included as an integral part of it. Therefore the whole numbering of titles, figures and tables, etc., is an indivisible part – an element of 1. Engineering Geodesy.

In the literature dedicated to physical planning, focused at regulation plans, general plans, vertical planning and the geodetic aspects of their design and implementation, there are practically few fundamental works and some of them are relatively outdated in terms of – legislation, technologies of development and application. All of them, along with the current legislative basis, and many others, of course, have found reflection in the proposed work.

The book contains many examples from practice, including from real projects, fragments of them, together with the symbols used. It has to be noted that regardless of the existing Regulation No 8 from 2001 [28] there are differences in the symbols applied. There are also differences between the symbols for settlements and industrial enterprises, airports and other complex objects for one and the same type of objects. The difference is also enhanced by the fact that the available symbols in the Regulation for symbols in general plans are not intended for automated drawing and software designers develop and use new symbols. New updating and unification of the symbols for physical planning are necessary. Obviously **alteration and unification of symbols** should be introduced in order to use them throughout the country and in **the different types of physical and general plans**, as well as bring them to a form suitable for digital design and development of plans.

Maybe this is the place to point out the fact that there are many common aspects of the role of the two sciences – architecture and geodesy, in life and practice. In fact both architecture and geodesy contribute except to solving their own problems also to solve basic problems of other sciences and fields of knowledge and life.

The decimal system of numbering is used in the book. Due to the great number of title levels, for better clarity, certain simplification is applied here by introducing double four-level numbering. It is expressed in the introduction of conventional four-level numbering, and when it has to be exceeded – introducing a new additional four-level numbering where necessary.

The authors acknowledge the gratitude a number of colleagues and professionals for the cooperation and assistance in the preparation and realization of this book.

Sofia, 28.09.2016, revised 2022 The authors

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2.1. Nature of the vertical planning of streets and cases of design of axial junctions for streets intersecting at right angles
2.2. Analytical design of street intersections

Cor. Mem. Prof. Dr. Eng. Georgi Milev. Graduate of the University of Architecture, Civil Engineering and Geodesy (UACEG), Sofia (1956). In 1960 – Research Associate in the Bulgarian Academy of Sciences (BAS). In 1976 – Associate Professor, 1985 – Professor, 2008 – Cor. Mem. of BAS. Since 1988 – Cor. Mem. of the Bavarian Academy of Sciences, Germany. In 1973 – defended a PhD thesis in the Stuttgart University. Since 2001 – lectures to the students on Geodesy and Engineering Geodesy in UACEG, German lingual education.

The scope of his diverse and efficient activities is significant – scientific, applied research, scientific-organizational, educational, international, promotional, publishing, inventive, expert, scientific managerial and implementation. Basically, these activities were carried out in BAS, the Federation of Scientific Technical Unions in Bulgaria (FSTUB), the Union of Scientists in Bulgaria, UACEG and other institutions in Bulgaria and in international organizations and projects, mostly on an interdisciplinary ground.

The scientific activity of Prof. Milev covers both aspects of geodesy – natural and engineering. The number of his publications exceeds 580, of them 16 separate monographs, 9 studies, 5 books – each one of which is a system of monographs, 26 editing and publishing of scientific proceedings, 120 scientific papers, 243 scientific reports, etc. He was awarded by Stuttgart University for high scientific achievements of his thesis (1973).

Prof. Milev is honorary member of the International Federation of Surveyors (FIG), FSTUB and others. He had been a chairman of the Union of Surveyors and Land Managers in Bulgaria since 1990 for 24 years and later – its honorary chairman. He is Editor in chief of the Geodesy, Cartography and Land Management magazine since 1997. Member of BAS. Space research and Technologies Institute.

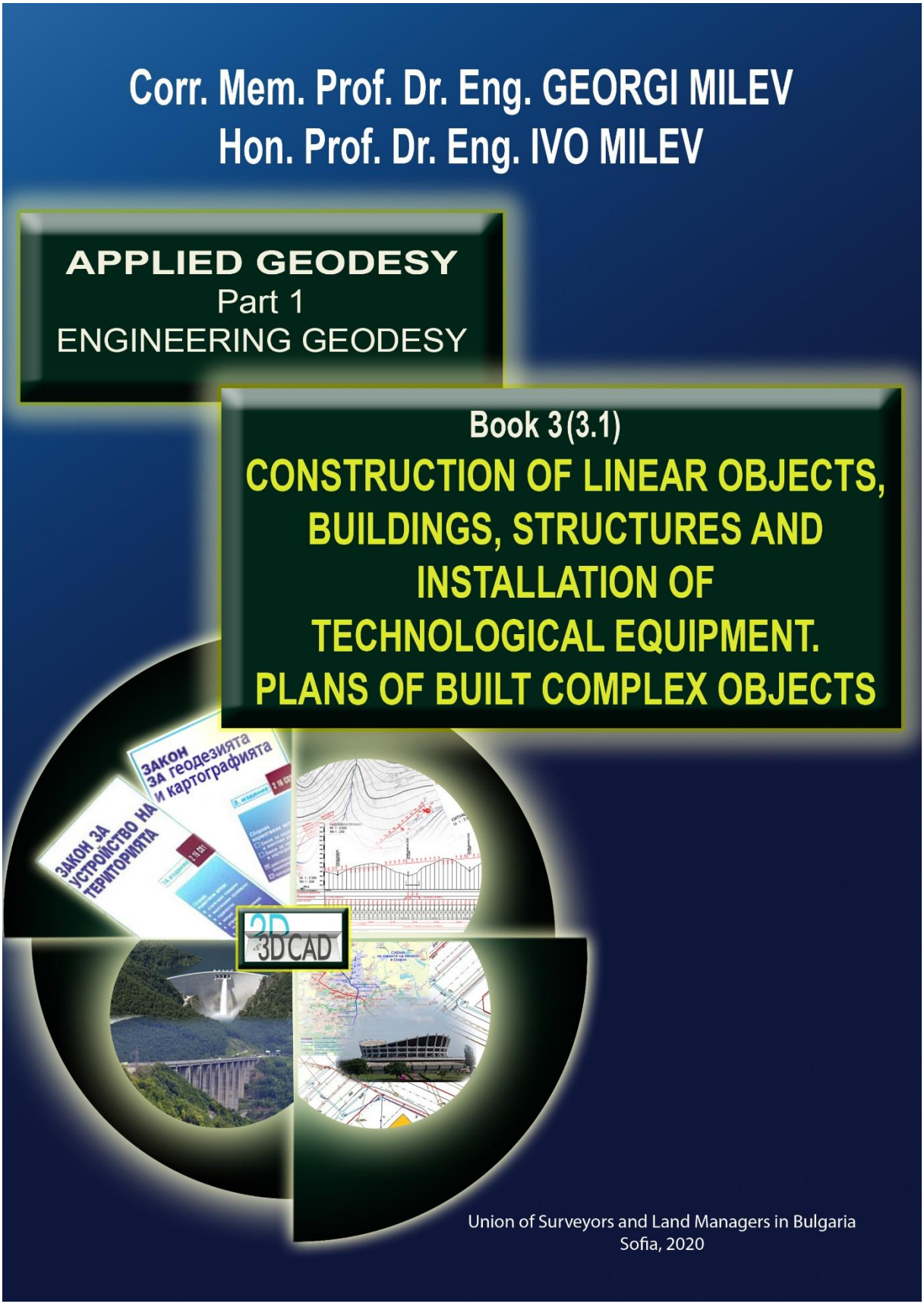
Honorary Prof. Dr. Eng. Ivo Milev graduated geodesy and mine surveying at the University of Mining and Geology, Sofia in 1991. He defended his PhD thesis in 2000 at the Technical University, Berlin – direction Construction and Geodesy.

He works in both aspects of geodesy – engineering and natural, but mainly in the area of Applied Geodesy – Engineering Surveying. This includes primarily the development of theory, software and application of adjustment – processing the results of geodetic measurements; GNSS – theory, software and application, alone and combined with data from other measurements; theory and software and application in the study of deformations of engineering objects – buildings and facilities, and the terrains for their situation; modern techniques of measurement – electronic tachometry, laser scanning and others, development, software and application. Special attention is paid to transport objects, particularly to railroad parameters. He has registered two patents associated with his name in implementing the system of the Leika Concern Geosystems.

He was: expert of UN – OOSA on reference systems; member of the Steering Committee of EUPOS (EUropean Positioning Determination System); chairman of Working Group Private Services RTCM SC 104 (Radio Technical Commission for Maritime Services); guest professor at Beuth University of Applied Sciences in Berlin, East Kazakhstan Technical University, State Technical University of Kazakhstan and Siberian State Geodetic Academy.

Prof. Ivo Milev is a member of Working Group 4 Engineering Surveying of the Union of German Surveyors; Chairman of Commission 6 Engineering Geodesy of the International Federation of Surveyors for the period 2013-2017. He is an Executive Director of TechNet-rail GmbH. He is Honorary Prof. of the Siberian State Geodetic Academy, Russia and of the Technical University of Dresden, Germany.

3.3. BOOK 3.1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APPLIED GEODESY
Part 1
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CONSTRUCTION OF LINEAR OBJECTS, BUILDINGS, STRUCTURES AND INSTALLATION OF TECHNOLOGICAL EQUIPMENT. PLANS OF BUILT COMPLEX OBJECTS
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2D & 3D CAD
Union of Surveyors and Land Managers in Bulgaria
Sofia, 2020

Corr. Mem. Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV

APPLIED GEODESY

Part 1

ENGINEERING SURVEYING

Book 3 (3.1)

CONSTRUCTION OF LINEAR OBJECTS, BUILDINGS, FACILITIES AND INSTALLATION OF TECHNOLOGICAL EQUIPMENT. PLANS OF THE BUILT COMPLEX SITES

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2020, revised 2022

Annotation

Book 3, Part 1, Engineering Surveying, Applied Geodesy considers the nature, tasks and role of Engineering Surveying in the **design, tracing, construction and operation** of **specific types** of engineering objects – linear objects, buildings, facilities and installation of technological equipment, plans and information systems of the built complex sites, etc.

Due to the versatility of the problems treated and the large volume of the matter discussed, exceeding 1000 computer pages, Book 3 is issued as two books – Book 3.1 and Book 3.2.

The specificity of geodetic works in the design and construction of linear objects (roads, railways, main pipelines, etc.) and the facilities along them (bridges, road junctions, tunnels, also metropolitans, etc. – ***Book 3.1, without bridges***) are considered, as well as geodetic works related with methods, technologies, tracing and control measurements during the construction and installation of buildings, facilities (dams, sport and civil and high-rise structures, etc.) and installation of machines for various purposes, built independently or in complexes of engineering objects, ***as well as hydro melioration objects and corrections of rivers and floods – Book 3.2***. Further on the composition of plans is presented for the built objects and the cadastre of communications of the complexes of engineering objects and relevant information systems. The exposition here provides first brief specific information about the essence, construction, requirements and legal basis and features of the various objects. So, among other things, up-to-date engineering information and terminology are used and experts speak the same language, even more so that the problems addressed are interdisciplinary ones.

The book is with an original structure. The exposition is in conformity with the accepted way of presentation in Books 1 and 2 of the authors, with the current regulatory framework and the possibilities afforded by modern digital devices, instruments, systems and technologies. It reflects to a significant extent the views, years of research, teaching experience, involvement in the construction and study of deformations of engineering objects, including such with original spatial design solutions, realized with the participation of the authors.

The book is intended for specialists working on construction (exploration, design, construction, installation) and operation of various engineering objects and complexes of them, as well as for lecturers, PhD students, students in the area of Architecture, Civil Engineering and Geodesy, etc., and for practitioners in the field of Engineering Surveying, recommendably with the other two books.

We dedicate to: Natalia Ivanova Mileva *– wife and mother*

The authors

Reviewers:

1. Corr. Member Prof. D.Sc. Dr Arch. Atanas Kovachev,
   Assoc. Prof. Dr. Eng. Veneta Kotseva
2. Assoc. Prof. Dr. Eng. Todor Kostadinov
3. Dr Eng. Ivan Kalchev Ivanov

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Preface

The book **"Construction of linear objects, buildings, facilities and installation of technological equipment. Plans of the built complex objects"** is part of the **Applied Geodesy** project of the authors, consisting of three parts: **1. Engineering Surveying, 2. Natural scientific aspect of Geodesy application, 3. Other applications of Geodesy.** The three together treat the versatile application of geodesy.

This is in fact the third book – Book 3 of Part 1. Engineering Surveying, which is issued in the form of **3 books**. Book 1 **Basics, systems and technologies in Engineering Surveying** (498 p.) and Book 2 **Design and implementation of physical and general plans** (330 p.) are already distributed in digital form by the electron bookstore [http://Biblio.bg] and in an analog form by the bookstores of UACEG, UMG, SEK bookstore for building literature and others. They were printed in the Avangard Publishing House and are editions of the Union of Surveyors and Land Managers in Bulgaria (Ed. No 978-619-90732).

The reason for the separate publication of this part of the problems of Engineering Surveying as a single book – Book 3 is: the **large volume** of the materials on Engineering Surveying; the **specifics** and thematic distinguishing of the topics; the realized for the first time **differentiation, systematization, generalization and representation** of the modern achievements in this area in the form of **systems, methods and technologies** (a basic, indivisible element and a prerequisite – theoretical and practical, for the subsequent realization also of individual specific engineering objects or a complex of them); the **necessity** of broader presentation of the issues on exploration, design, construction, control and investigation of the deformations of particular objects or complexes of them, due to the fact that many complex specific problems emerge and have to be solved by the surveyors. Unfortunately, there are a few or no examples and detailed generalizations for this in reference literature. However the authors consider that it is very useful to summarize the information and experience in this context and to present it to the surveyors, since the experience in engineering surveying is of extreme importance for solving the problems; the **broad circle of specialists**, working particularly only in this area. Last but not least, its separate publication will make it **much easier accessible** and convenient for use. This is also enhanced by its realization with the modern possibilities of digital publication and use, including with mobile devices.

As already mentioned in the annotation – Book 3 has to be issued in two parts – Book 3.1 and Book 3.2.

At the same time there is planned, immediate and inevitable connection between the matter treated here and its specific implementation and the other two books of 1. Engineering Surveying. The application during construction is implied – the design, tracing and control in the course of the building process and installation of the different types of specific engineering objects and complexes of them. This means that the three books represent a whole, an integral organic entity – Engineering Surveying. Therefore, the numbering of titles, figures and tables, etc., are an indivisible part – an element of 1. Engineering Surveying. This also determines the inclusion of this book further in a unified digital edition as 1. Engineering Surveying. In fact, as already noted, it was initially included as an indivisible part of it. Something that has not been done so far in the world literature in this area.

In the literature devoted to Engineering Surveying there are actually a few complete specialized works, dedicated entirely to Engineering Surveying. However, there are a lot of those dedicated to specific applications of Engineering Surveying. They have found to a great extent their place in the offered work, of course together with the modern legal basis.

In Book 3, as well as in the already issued books – 1 and 2, the **decimal numbering system** is used. Due to the large number of titles and their multiple stages, for the sake of clarity, simplification has been made here by introducing sequentially a four-stage numbering as in our

previously mentioned Books 1 and 2. It consists in introducing the conventional four-stage numbering, applying when necessary, a new additional four-stage numbering in the cases, when it has to be exceeded.

In the third book however, **the individual sections had to be formatted independently** in terms of **numbering** of reference literature, figures, tables and formulas due to the complexity and multifarious nature of continuous numbering. Such a problem actually arises here as with quoting text titles, although not quite often. So, except for the accepted rule for citing from one book to another, for the three books, new moments of citing appear here for quoting from one section to another in Book 3. It is accepted to place the number of the section before the cited number of a figure, table, formula, reference literature. For example, if it is necessary to cite Fig. 56 of section 3.6 – bridges, in some other section, citing in the other section has the form (Fig. 3.6-56, respectively Table 3.6-5, formula 3.6-35, reference literature source [3.6-25]). In this way the identity is ensured.

The authors acknowledge their gratitude to the Union of Surveyors and Land Managers in Bulgaria for issuing the book under its auspices, as well as for the assistance and support rendered for the preparation and realization of the book. We also express our gratitude to the reviewers Corr. Mem. Prof. D.Sc. Dr. Arch. Atanas Kovachev and the co-reviewer Assoc. Prof. Dr. Eng. Veneta Kotseva, to Assoc. Prof. Dr. Eng. Todor Kostadinov and Dr. Eng. Ivan Kalchev Ivanov for the positive reviews of the book. We also thank Assist. Prof. Eng. Ivo Gadzhov for the cooperation in presenting digital road design, Eng. Georgi Lazarov, Eng. Yavor Dimitrov and Eng. Petar Vuchev for the effective cooperation in preparing parts for Hydrotechnical Construction, respectively to Eng. Ivailo Iliev for the gas-distribution pipelines and M.Sc. Econ. Ilian Panchev for the effective collaboration in solving problems with the computer preparation of the book. Our gratitude is also acknowledged in some sections to other colleagues with contribution to the realization of their topics.

Special thanks are due to the unreserved and active cooperation of Eng. Kristina Galabova for preparing the tables, formulas and most of the figures for press, compiling the index, etc., as well as to Svetla Petrova and Eng. Ivanka Koleva for elaborating the title page of the book and to Eng. Ekaterina Krusteva for translating parts of the book to English.

Sofia, December, 2019, revised 2022 The authors

CONTENTS of Book 3.1

Cor. Mem. Prof. Dr. Eng. Georgi Milev. Graduate of the University of Architecture, Civil Engineering and Geodesy (UACEG), Sofia (1956). In 1960 – Research Associate in the Bulgarian Academy of Sciences (BAS). In 1976 – Associate Professor, 1985 – Professor, 2008 – Cor. Mem. of BAS. Since 1988 – Cor. Mem. of the Bavarian Academy of Sciences, Germany. In 1973 – defended a PhD thesis in the Stuttgart University. Since 2001 – lectures to the students on Geodesy and Engineering.

The scope of his diverse and efficient activities is significant – scientific, applied research, scientific-organizational, educational, international, promotional, publishing, inventive, expert, scientific managerial and implementation. Basically, these activities were carried out in BAS, the Federation of Scientific Technical Unions in Bulgaria (FSTUB), the Union of Scientists in Bulgaria, UACEG and other institutions in Bulgaria and in international organizations and projects, mostly on an interdisciplinary ground.

The scientific activity of Prof. Milev covers both aspects of geodesy – natural and engineering. The number of his publications exceeds 580, of them 16 separate monographs, 9 studies, 5 books – each one of which is a system of monographs, 26 editing and publishing of scientific proceedings, 120 scientific papers, 243 scientific reports, etc. He was awarded by Stuttgart University for high scientific achievements of his thesis (1973).

Prof. Milev is honorary member of the International Federation of Surveyors (FIG), FSTUB and others. He had been a chairman of the Union of Surveyors and Land Managers in Bulgaria since 1990 for 24 years and later – its honorary chairman. He is Editor in chief of the Geodesy, Cartography and Land Management magazine since 1997. Member of BAS. Space research and Technologies Institute.

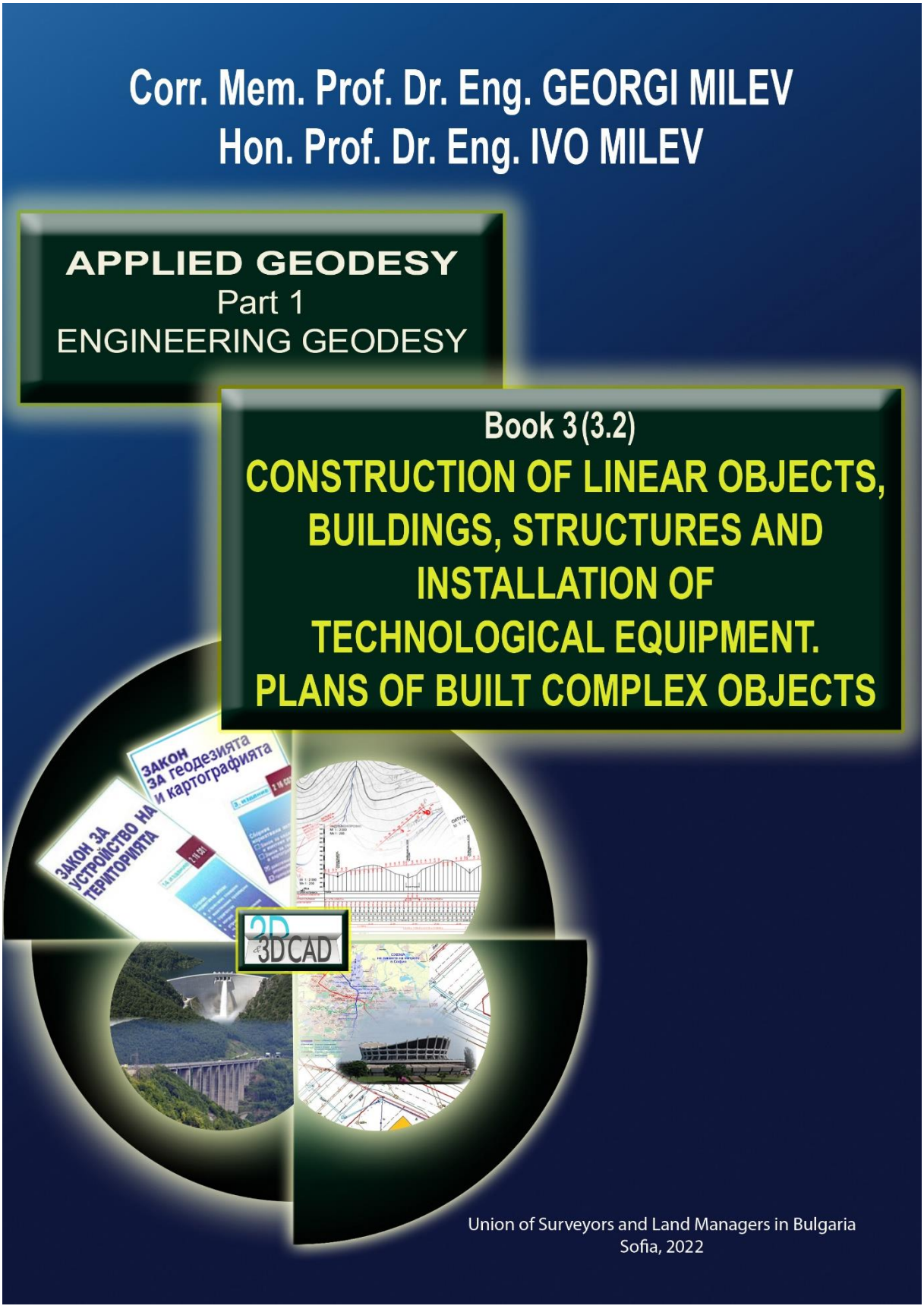
Honorary Prof. Dr. Eng. Ivo Milev graduated geodesy and mine surveying at the University of Mining and Geology, Sofia in 1991. He defended his PhD thesis in 2000 at the Technical University, Berlin – direction Construction and Geodesy.

He works in both aspects of geodesy – engineering and natural, but mainly in the area of Applied Geodesy – Engineering Surveying. This includes primarily the development of theory, software and application of adjustment – processing the results of geodetic measurements; GNSS – theory, software and application, alone and combined with data from other measurements; theory and software and application in the study of deformations of engineering objects – buildings and facilities, and the terrains for their situation; modern techniques of measurement – electronic tachometry, laser scanning and others, development, software and application. Special attention is paid to transport objects, particularly to railroad parameters. He has registered two patents associated with his name in implementing the system of the Leika Concern Geosystems.

He was: expert of UN – OOSA on reference systems; member of the Steering Committee of EUPOS (EUropean Positioning Determination System); chairman of Working Group Private Services RTCM SC 104 (Radio Technical Commission for Maritime Services); guest professor at Beuth University of Applied Sciences in Berlin, East Kazakhstan Technical University, State Technical University of Kazakhstan and Siberian State Geodetic Academy.

Prof. Ivo Milev is a member of Working Group 4 Engineering Surveying of the Union of German Surveyors; Chairman of Commission 6 Engineering Geodesy of the International Federation of Surveyors for the period 2013-2017. He is an Executive Director of TechNet-rail GmbH. He is Honorary Prof. of the Siberian State Geodetic Academy, Russia and of the Technical University of Dresden, Germany.

3.4. BOOK 3.2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2D & 3DCAD
Union of Surveyors and Land Managers in Bulgaria
Sofia, 2022

Corr. Mem. Prof. Dr. Eng. GEORGI MILEV

Hon. Prof. Dr. Eng. IVO MILEV

APPLIED GEODESY

Part 1

ENGINEERING SURVEYING

Book 3(3.2)

CONSTRUCTION OF LINEAR OBJECTS, BUILDINGS, FACILITIES AND INSTALLATION OF TECHNOLOGICAL EQUIPMENT. PLANS OF THE BUILT COMPLEX OBJECTS

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2022

Annotation

Books 3 of Part 1, Engineering Surveying of Applied Geodesy, consider the nature, tasks and role of Engineering Surveying in the **design, tracing, construction and operation** of **specific types** of engineering objects – linear objects, buildings, facilities and installation of technological equipment, plans, models and information systems of built complex sites, etc.

Due to the versatility of the problems treated and the large volume of the matter discussed, exceeding 1500 computer pages, Book 3 is issued as three books – 3(3.1), 3(3.2) and 3(3.3).

Book 3(3.1) presents the design, construction, operation and reconstruction of linear objects and the specificities of geodetic works for railways, roads, objects of electric supply, communications, water supply and sewerage, cable-ways as well as tunnels and metro lines.

Book 3(3.2) includes the problems related to the design, construction and installation of facilities along other linear objects, e.g., bridges, as well as geodetic methods and technologies for tracing, control measurements and studies of their deformations. The same problems are also considered for hydrotechnical objects, built independently or in complexes of engineering ones – dams, cascades, etc., as well as hydro melioration objects, river corrections, floods and droughts and ports.

Book 3(3.3) presents the research, design, tracing and control and deformation studies during the construction, assembly and operation of buildings, industrial facilities and technological equipment, installation of machines for various purposes, as well as civil objects – airports, sport, high-rise objects, etc. Further on the composition of plans and modelling is shown for the built objects – BIM (Building Information Models) and the cadastre of communications of complexes of engineering objects and relevant information systems, respectively – Specialized Data (model) of underground communications, as well as other engineering aspects of application.

The exposition in 3(3.1), 3(3.2) and 3(3.3) provides first brief **specific information about the essence, construction, requirements, regulatory base and features of the various objects.** So, among other things, ***up-to-date*** engineering information and terminology are used and experts speak the same language, even more so that the problems addressed are ***interdisciplinary*** ones.

The book is with an original **structure**. The exposition is in conformity with the accepted way of presentation in Books 1 and 2 of the authors, with the current regulatory framework and the possibilities afforded by modern digital devices, instruments, systems and technologies. It **reflects** to a significant extent the views, years of research, teaching experience, involvement in the construction and study of deformations of engineering objects, including such with original spatial design solutions, implemented with the participation of the authors.

Books 3(3.1), 3(3.2) and 3(3.3) are intended for specialists working on construction (research, design, construction, installation) and operation of various engineering objects and complexes of them, as well as for lecturers, PhD students, students in the area of Architecture, Civil Engineering and Geodesy, etc., and for practitioners in the field of construction and engineering surveying, recommendably with books 1 and 2.

We dedicate to: Natalia Ivanova Mileva – wife and mother.

The entire edition of 5 books {1, 2 and 3(3.1), 3(3.2), 3(3.3)} of Engineering Surveying we also dedicate to the 150th Anniversary of the Bulgarian Academy of Sciences.

The authors

Reviewers:
1. Corr. Member Prof. D.Sc. Dr Arch. Atanas Kovachev,
Assoc. Prof. Dr Eng. Veneta Kotseva
2. Assoc. Prof. Dr Eng. Todor Kostadinov
3. Assoc. Prof. Dr Eng. Lachezar Hrischev
4. Dr Eng. Ivan Kalchev Ivanov

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Preface

Book 3 **"Construction of linear objects, buildings, facilities and installation of technological equipment. Plans of the built complex objects"** is issued, as already mentioned, in three separate books **– 3(3.1), 3(3.2) and 3(3.3).**

They are part of the **Applied Geodesy** project of the authors, consisting of three parts: **1. Engineering Surveying, 2. Natural scientific aspect of Geodesy application, 3. Other applications of Geodesy.** The three together treat the versatile application of geodesy.

Part 1. **Engineering Surveying** is issued in the form of Book 1 **Basics, systems and technologies in Engineering Surveying** – 498 p., and Book 2 **Design and implementation of development and master (physical) plans** – 330 p., which together with **Book 3(3.1) Construction of linear objects, buildings, facilities and installation of technological equipment. Plans of the built complex objects –** 524 p., are already in digital form and are distributed by the electronic bookstore [http://Biblio.bg] and in an analogue form by the bookstores of UACEG, UMG, SEK bookstore for building literature and others. They are issued by the Avangard Publishing House and are **editions** of the **Union of Surveyors and Land Managers in Bulgaria** (Ed. No 978-619-90732), supported by BAS and SRTI. Book 3 (3.2) - 530 pages and Book 3 (3.3) - 466 pages, bearing the same title as Book 3.1, will also be distributed there.

The reason for the separate publication of part of the problems of Engineering Surveying in books 3(3.1), 3(3.2), 3(3.3), as already mentioned, is on the one hand: the **large volume** of the materials on Engineering Surveying; and on the other hand the **specifics** and thematic distinguishing of the topics; the realized for the first time **differentiation, systematization, generalization and representation** of the modern achievements in this area in the form of **systems, methods and technologies** (a basic, indivisible element and a prerequisite – theoretical and practical, for the subsequent realization also of individual specific engineering objects or a complex of them); the **necessity** of broader presentation of the issues of research, design, construction, control and studies of the deformations of particular objects or complexes of them, due to the fact that many complex specific problems emerge and have to be solved by the surveyors. Unfortunately, there are a few or no examples and detailed generalizations for this in reference literature. However the authors consider that it is very useful to summarize the information and experience in this context and to present it to the surveyors, since the experience in engineering surveying is of extreme importance for solving the problems; and to the **broad circle of specialists**, working particularly only in this area. Last but not least, its separate publication will make it **much easier accessible** and **convenient** for use. This is also enhanced by its realization with the modern possibilities of **digital publication and use**, including with mobile devices.

***Arguments have been pointed out for the publication of Book 3 as three books – books* 3(3.1), 3(3.2), 3(3.3).**

At the same time there is planned, immediate and inevitable connection between the matter treated here and its specific implementation and the other two books of Part 1. Engineering Surveying 1 and 2. The application during construction is implied – the design, tracing and control in the course of the building process, installation and operation of the different types of specific engineering objects and complexes of them. This means that the five books represent a whole, an integral organic entity – Engineering Surveying. Therefore, the whole numbering of titles, figures and tables, etc., is an indivisible part – an element of 1. Engineering Surveying. This also determines the inclusion of this book further on in a unified digital edition as 1. Engineering Surveying. In fact, as already noted, it was intended to be included as an indivisible part of it. Something that has not been done so far in the world literature in this area.

In the literature devoted to Engineering Surveying there are actually a few comprehensive specialized works, dedicated entirely to Engineering Surveying. However, there are a lot of those dedicated to specific applications of Engineering Surveying. They have found to a large extent their place in the offered work, of course together with the modern regulatory base.

In Books 3, as well as in the already issued two books – 1 and 2, the **decimal numbering system** is used. Due to the large number of titles and their multiple stages, for the sake of clarity, an original simplification has been made here by introducing sequentially a four-stage numbering as in our previously mentioned Books 1 and 2. It consists in introducing the conventional four-stage numbering, applying if necessary, new additional one or two four-stage numbering in the cases, when it has to be exceeded.

In books 3 however, **the individual sections had to be formatted independently** in terms of **numbering** of reference literature, figures, tables and formulas due to the complexity and multifarious nature of continuous numbering. Such a problem actually arises here as with quoting text titles, although not quite often. So, except for the accepted rule for citing from one book to another, for the five books, new moments of citing appear here for quoting from one section to another in books 3. It is accepted to place the number of the section before the cited number of a figure, table, formula, reference literature. For example, if it is necessary to cite Fig. 56 of section 3.6 – bridges, in some other section, citing in the other section has the form Fig. 3.6-56, respectively Table 3.6-5, formula 3.6-35, reference literature source [3.6-25]). In this way the identity is ensured.

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We owe special gratitude to Eng. Kristina Galabova for the unreserved and active cooperation in preparing the tables, formulas and most of the figures for press, compiling the indices, etc., as well as to Svetla Petrova and Eng. Ivanka Koleva for elaborating the title page of the book and to Eng. Ekaterina Krusteva for translating parts of the book to English.

Sofia, March, 2022 The authors

CONTENTS of Book 3(3.2)

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The scope of his diverse and efficient activities is significant – scientific, applied research, scientific-organizational, educational, international, promotional, publishing, inventive, expert, scientific managerial and implementation. Basically, these activities were carried out in BAS, the Federation of Scientific Technical Unions in Bulgaria (FSTUB), the Union of Scientists in Bulgaria, UACEG and other institutions in Bulgaria and in international organizations and projects, mostly on an interdisciplinary ground.

The scientific activity of Prof. Milev covers both aspects of geodesy – natural and engineering. The number of his publications exceeds 580, of them 16 separate monographs, 9 studies, 5 books – each one of which is a system of monographs, 26 editing and publishing of scientific proceedings, 120 scientific papers, 243 scientific reports, etc. He was awarded by Stuttgart University for high scientific achievements of his thesis (1973).

Prof. Milev is honorary member of the International Federation of Surveyors (FIG), FSTUB and others. He had been a chairman of the Union of Surveyors and Land Managers in Bulgaria since 1990 for 24 years and later – its honorary chairman. He is Editor in chief of the Geodesy, Cartography and Land Management magazine since 1997. Member of BAS. Space research and Technologies Institute.

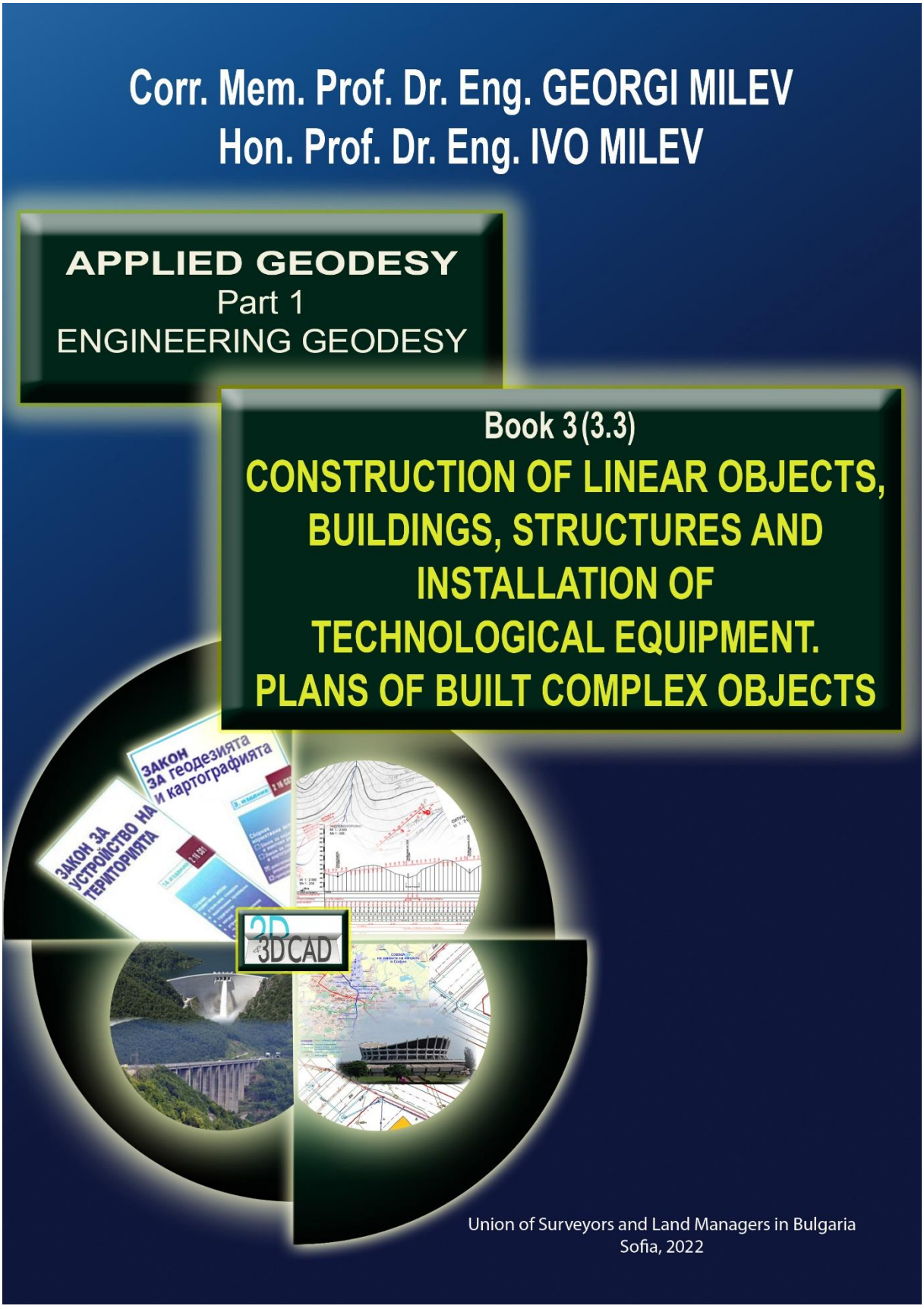
Honorary Prof. Dr. Eng. Ivo Milev graduated geodesy and mine surveying at the University of Mining and Geology, Sofia in 1991. He defended his PhD thesis in 2000 at the Technical University, Berlin – direction Construction and Geodesy.

He works in both aspects of geodesy – engineering and natural, but mainly in the area of Applied Geodesy – Engineering Surveying. This includes primarily the development of theory, software and application of adjustment – processing the results of geodetic measurements; GNSS – theory, software and application, alone and combined with data from other measurements; theory and software and application in the study of deformations of engineering objects – buildings and facilities, and the terrains for their situation; modern techniques of measurement – electronic tachometry, laser scanning and others, development, software and application. Special attention is paid to transport objects, particularly to railroad parameters. He has registered two patents associated with his name in implementing the system of the Leika Concern Geosystems.

He was: expert of UN – OOSA on reference systems; member of the Steering Committee of EUPOS (EUropean Positioning Determination System); chairman of Working Group Private Services RTCM SC 104 (Radio Technical Commission for Maritime Services); guest professor at Beuth University of Applied Sciences in Berlin, East Kazakhstan Technical University, State Technical University of Kazakhstan and Siberian State Geodetic Academy.

Prof. Ivo Milev is a member of Working Group 4 Engineering Surveying of the Union of German Surveyors; Chairman of Commission 6 Engineering Geodesy of the International Federation of Surveyors for the period 2013-2017. He is an Executive Director of TechNet-rail GmbH. He is Honorary Prof. of the Siberian State Geodetic Academy, Russia and of the Technical University of Dresden, Germany.

3.5. BOOK 3.3


Corr. Mem. Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV
APPLIED GEODESY
Part 1
ENGINEERING GEODESY
Book 3 (3.3)
CONSTRUCTION OF LINEAR OBJECTS, BUILDINGS, STRUCTURES AND INSTALLATION OF TECHNOLOGICAL EQUIPMENT. PLANS OF BUILT COMPLEX OBJECTS
ЗАКОН ЗА ГЕОДЕЗИЯТА И КАРТОГРАФИЯТА
ЗАКОН ЗА УСТРОЙСТВО НА ТЕРИТОРИЯТА
2D & 3DCAD
Union of Surveyors and Land Managers in Bulgaria
Sofia, 2022

Prof. Dr. Eng. GEORGI MILEV
Hon. Prof. Dr. Eng. IVO MILEV

APPLIED GEODESY

Part 1

ENGINEERING SURVEYING

/

Book 3 (3.3)

CONSTRUCTION OF LINEAR OBJECTS, BUILDINGS, FACILITIES AND INSTALLATION OF TECHNOLOGICAL EQUIPMENT. PLANS OF THE BUILT COMPLEX OBJECTS

Union of Surveyors and Land Managers in Bulgaria
Sofia, 2022

Annotation

Books 3 of Part 1, Engineering Surveying of Applied Geodesy, consider the nature, tasks and role of Engineering Surveying in the **design, tracing, construction and operation** of **specific types** of engineering objects – linear objects, buildings, facilities and installation of technological equipment, plans, models and information systems of built complex sites, etc.

Due to the versatility of the problems treated and the large volume of the matter discussed, exceeding 1500 computer pages, Book 3 is issued as three books – 3(3.1), 3(3.2) and 3(3.3).

Book 3(3.1) presents the design, construction, operation and reconstruction of linear objects and the specificities of geodetic works for railways, roads, objects of electric supply, communications, water supply and sewerage, cable-ways as well as tunnels and metro lines.

Book 3(3.2) includes the problems related to the design, construction and installation of facilities along other linear objects, e.g., bridges, as well as geodetic methods and technologies for tracing, control measurements and studies of their deformations. The same problems are also considered for hydrotechnical objects, built independently or in complexes of engineering ones – dams, cascades, etc., as well as hydromelioration objects, river corrections, floods and droughts and ports.

Book 3(3.3) presents the research, design, tracing and control and deformation studies during the construction, assembly and operation of buildings, industrial facilities and technological equipment, installation of machines for various purposes, as well as civil objects – airports, sport, high-rise objects, etc. Further on the composition of plans and modeling is shown for the built objects – BIM (Building Information Models) and the cadastre of communications of complexes of engineering objects and relevant information systems, respectively – Specialized Data (model) of underground communications, as well as other engineering aspects of application.

The exposition in 3(3.1), 3(3.2) and 3(3.3) provides first brief **specific information about the essence, construction, requirements, regulatory base and features of the various objects.** So, among other things, ***up-to-date*** engineering information and terminology are used and experts speak the same language, even more so that the problems addressed are ***interdisciplinary*** ones.

The book is with an original **structure**. The exposition is in conformity with the accepted way of presentation in Books 1 and 2 of the authors, with the current regulatory framework and the possibilities afforded by modern digital devices, instruments, systems and technologies. It **reflects** to a significant extent the views, years of research, teaching experience, involvement in the construction and study of deformations of engineering objects, including such with original spatial design solutions, implemented with the participation of the authors.

Books 3(3.1), 3(3.2) and 3(3.3) are intended for specialists working on construction (research, design, construction, installation) and operation of various engineering objects and complexes of them, as well as for lecturers, PhD students, students in the area of Architecture, Civil Engineering and Geodesy, etc., and for practitioners in the field of construction and engineering surveying, recommendably with books 1 and 2.

We dedicate to: Natalia Ivanova Mileva – wife and mother.

The entire edition of 5 books {1, 2 and 3(3.1), 3(3.2), 3(3.3)} of Engineering Surveying we also dedicate to the 150th Anniversary of the Bulgarian Academy of Sciences.

The authors

Reviewers:
1. Corr. Member Prof. D.Sc. Dr Arch. Atanas Kovachev,
   Assoc. Prof. Dr Eng. Veneta Kotseva
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3. Dr Eng. Ivan Kalchev Ivanov

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Preface

Book 3 **"Construction of linear objects, buildings, facilities and installation of technological equipment. Plans of the built complex objects"** is issued, as already mentioned, in three separate books **– 3(3.1), 3(3.2) and 3(3.3).**

They are part of the **Applied Geodesy** project of the authors, consisting of three parts: **1. Engineering Surveying, 2. Natural scientific aspect of Geodesy application, 3. Other applications of Geodesy.** The three together treat the versatile application of geodesy.

Part 1. **Engineering Surveying** is issued in the form of Book 1 **Basics, systems and technologies in Engineering Surveying** – 498 p., and Book 2 **Design and implementation of development and master (physical) plans** – 330 p., which together with **Book 3(3.1) Construction of linear objects, buildings, facilities and installation of technological equipment. Plans of the built complex objects –** 524 p., are already in digital form and are distributed by the electronic bookstore [http://Biblio.bg] and in an analog form by the bookstores of UACEG, UMG, SEK bookstore for building literature and others. They are issued by the Avangard Publishing House and are **editions** of the **Union of Surveyors and Land Managers in Bulgaria** (Ed. No 978-619-90732), supported by BAS and SRTI. Book 3 (3.2) - 530 pages and Book 3 (3.3) - 466 pages, bearing the same title as Book 3.1, will also be distributed there.

The reason for the separate publication of part of the problems of Engineering Surveying in books 3(3.1), 3(3.2), 3(3.3), as already mentioned, is on the one hand: the **large volume** of the materials on Engineering Surveying; and on the other hand the **specifics** and thematic distinguishing of the topics; the realized for the first time **differentiation, systematization, generalization and representation** of the modern achievements in this area in the form of **systems, methods and technologies** (a basic, indivisible element and a prerequisite – theoretical and practical, for the subsequent realization also of individual specific engineering objects or a complex of them); the **necessity** of broader presentation of the issues of research, design, construction, control and studies of the deformations of particular objects or complexes of them, due to the fact that many complex specific problems emerge and have to be solved by the surveyors. Unfortunately, there are a few or no examples and detailed generalizations for this in reference literature. However, the authors consider that it is very useful to summarize the information and experience in this context and to present it to the surveyors, since the experience in engineering surveying is of extreme importance for solving the problems; and to the **broad circle of specialists**, working particularly only in this area. Last but not least, its separate publication will make it **much easier accessible** and **convenient** for use. This is also enhanced by its realization with the modern possibilities of **digital publication and use**, including with mobile devices.

***Arguments have been pointed out for the publication of Book 3 as three books – books* 3(3.1), 3(3.2), 3(3.3).**

At the same time there is planned, immediate and inevitable connection between the matter treated here and its specific implementation and the other two books of Part 1. Engineering Surveying 1 and 2. The application during construction is implied – the design, tracing and control in the course of the building process, installation and operation of the different types of specific engineering objects and complexes of them. This means that the five books represent a whole, an integral organic entity – Engineering Surveying. Therefore the whole numbering of titles, figures and tables, etc., is an indivisible part – an element of 1. Engineering Surveying. This also determines the inclusion of this book further on in a unified digital edition as 1. Engineering Surveying. In fact, as already noted, it was intended to be included as an indivisible part of it. Something that has not been done so far in the world literature in this area.

In the literature devoted to Engineering Surveying there are actually a few comprehensive specialized works, dedicated entirely to Engineering Surveying. However, there are a lot of those dedicated to specific applications of Engineering Surveying. They have found to a large extent their place in the offered work, of course together with the modern regulatory base.

In Books 3, as well as in the already issued two books – 1 and 2, the **decimal numbering system** is used. Due to the large number of titles and their multiple stages, for the sake of clarity, an original simplification has been made here by introducing sequentially a four-stage numbering as in our previously mentioned Books 1 and 2. It consists in introducing the conventional four-stage numbering, applying if necessary, new additional one or two four-stage numbering in the cases, when it has to be exceeded.

In books 3 however, **the individual sections had to be formatted independently** in terms of **numbering** of reference literature, figures, tables and formulas due to the complexity and multifarious nature of continuous numbering. Such a problem actually arises here as with quoting text titles, although not quite often. So, except for the accepted rule for citing from one book to another, for the five books, new moments of citing appear here for quoting from one section to another in books 3. It is accepted to place the number of the section before the cited number of a figure, table, formula, reference literature. For example, if it is necessary to cite Fig. 56 of section 3.6 – bridges, in some other section, citing in the other section has the form Fig. 3.6-56, respectively Table 3.6-5, formula 3.6-35, reference literature source [3.6-25]). In this way the identity is ensured.

The authors acknowledge their gratitude to the **Union of Surveyors and Land Managers in Bulgaria** for issuing the book under its auspices, as well as for the assistance and support rendered for the preparation and realization of the book. We also thank **BAS** and **SRTI (the books are placed in the internet page of the institute) for their support**. We acknowledge our gratitude to the **reviewers** Corr. Mem. Prof. D.Sc. Dr Arch. Atanas Kovachev and the co-reviewer Assoc. Prof. Dr Eng. Veneta Kotseva {and in addition for her review and improvement of part of the manuscript of book 3(3.2)}, to Assoc. Prof. Dr Eng. Todor Kostadinov and Dr Eng. Ivan Kalchev {books 3(3.1), 3(3.2), 3(3.3)} for the positive reviews of the book and to M.Sc. Econ. Ilian Panchev for the efficient collaboration in solving problems with the computer preparation of the books. Our gratitude is also expressed in some sections to other colleagues with contribution to the realization of the topics. Special thanks to Prof. Dr Eng. Keranka Vasileva for the comprehensive comparative review and her suggestions for improving books 3(3.2) and 3(3.3).

We owe special gratitude to Eng. Kristina Galabova for the unreserved and active cooperation in preparing the tables, formulas and most of the figures for press, compiling the indices, etc., as well as to Svetla Petrova and Eng. Ivanka Koleva for elaborating the title page of the book and to Eng. Ekaterina Krusteva for translating parts of the book to English.

Sofia, March, 2022 The authors

CONTENTS of Book 3(3.3)

Cor. Mem. Prof. Dr. Eng. Georgi Milev. Graduate of the University of Architecture, Civil Engineering and Geodesy (UACEG), Sofia (1956). In 1960 – Research Associate in the Bulgarian Academy of Sciences (BAS). In 1976 – Associate Professor, 1985 – Professor, 2008 – Cor. Mem. of BAS. Since 1988 – Cor. Mem. of the Bavarian Academy of Sciences, Germany. In 1973 – defended a PhD thesis in the Stuttgart University. Since 2001 – lectures to the students on Geodesy and Engineering.

The scope of his diverse and efficient activities is significant – scientific, applied research, scientific-organizational, educational, international, promotional, publishing, inventive, expert, scientific managerial and implementation. Basically, these activities were carried out in BAS, the Federation of Scientific Technical Unions in Bulgaria (FSTUB), the Union of Scientists in Bulgaria, UACEG and other institutions in Bulgaria and in international organizations and projects, mostly on an interdisciplinary ground.

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He was: expert of UN – OOSA on reference systems; member of the Steering Committee of EUPOS (EUropean Positioning Determination System); chairman of Working Group Private Services RTCM SC 104 (Radio Technical Commission for Maritime Services); guest professor at Beuth University of Applied Sciences in Berlin, East Kazakhstan Technical University, State Technical University of Kazakhstan and Siberian State Geodetic Academy.

Prof. Ivo Milev is a member of Working Group 4 Engineering Surveying of the Union of German Surveyors; Chairman of Commission 6 Engineering Geodesy of the International Federation of Surveyors for the period 2013-2017. He is an Executive Director of TechNet-rail GmbH. He is Honorary Prof. of the Siberian State Geodetic Academy, Russia and of the Technical University of Dresden, Germany.

5. SUMMARY AND EVALUATION

5.1. ESSENCE, ROLE AND SIGNIFICANCE OF THE SYSTEMS OF MONOGRAPHS ON ENGINEERING GEODESY[1]

Corr. Mem. Dr Eng. Georgi Milev, BAS, SRTI
Hon. Prof. Dr Eng. Ivo Milev, Berlin, Germany

SUMMARY

The completed system of monographs on Applied Geodesy – Part 1. Engineering Geodesy (Engineering Surveying) is presented. In fact, it summarizes the current problems of construction, architecture, spatial planning and the role and place of geodesy – Engineering Geodesy in their implementation. Thereby, for the first time, construction activity, architecture, spatial planning and Engineering Geodesy are considered together in their essence. The exposition is from an interdisciplinary viewpoint, including Engineering Geodesy as an integral part of this complex activity, in which other specialists play also an incontrovertible role. The scope, volume, division, structure and content of the individual books on the subject are presented. A summary review, analysis and evaluation of the literature in the field of Engineering Geodesy have been made. The original solutions in the system of monographs and the corresponding generalized complex literature are presented. Practically the system of monographs is a digital whole with a volume of 2870 computer pages with uniform numbering of content, text, formulas, figures, tables and literature. The analogue edition covers 5 books.

Key words: Construction, Architecture, Spatial planning, Applied and Engineering Geodesy, system of monographs.

РЕЗЮМЕ

Представена е завършената система от монографии за Приложната геодезия – част 1 - Инженерна геодезия. Тя обобщава съвременните проблеми на строителството, архитектурата, устройството на територията и мястото и ролята на геодезията – Инженерната геодезия при тяхното реализиране. По този начин, за първи път, строителната дейност, архитектурата, устройството на територията и Инженерната геодезия са изложени заедно по същество. Изложението е от интердисциплинарна позиция, включвайки Инженерната геодезия като **неотменен елемент** на тази **комплексна дейност, в която безспорна роля имат и други специалисти**. Представени са обхвата, обема, поделянето, структурата и съдържанието на отделните книги по въпроса. Направен е обобщен преглед, анализ и оценка на литературата в областта на Инженерната геодезия. Изложени са оригиналните решения в системата от монографии и съответна обобщена комплексна литература. Практически системата от монографии е едно дигитално цяло, с обем от 2870 компютърни страници с единна номерация на съдържание, текст, формули, фигури, таблици и литература. Аналоговото издание обхваща 5 книги.

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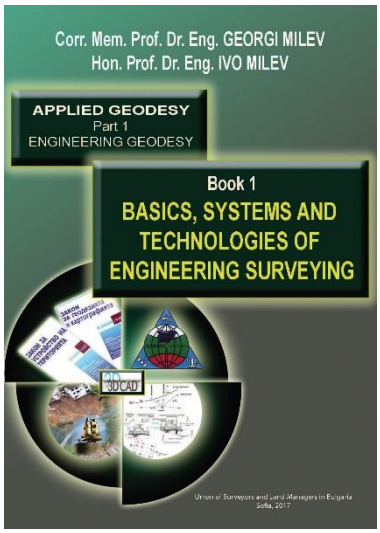
[1]Милев, Г. И. Милев. Същност, роля и значение на системата от монографии в инженерната геодезия. СГЗБ. С. Геодезия, картография, земеустройство. 2022,1-2, 3-8

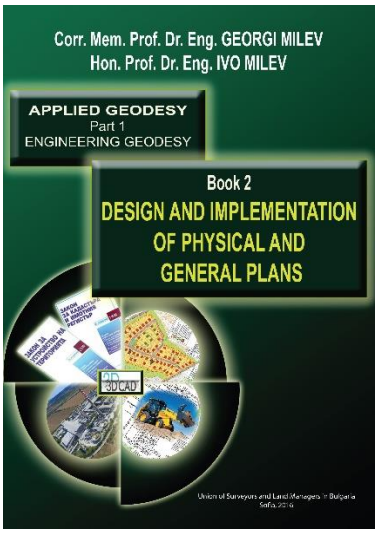
Milev (BG), G., I. Milev (DE). Essence, Role and Significance of The Systems of Monographs on Engineering Geodesy. XXXII International symposium on modern technologies, education and professional practice in geodesy and related fields. Sofia, November 2 – 4, 2022

Ключови думи: Строителство, Архитектура, Устройство на териториите, Приложна и Инженерна геодезия, система от монографии.

1. GENERAL DATA

After eight years of work, the **system of monographs** on Applied Geodesy – Part 1. Engineering Geodesy was completed [5], [6], [7] (Fig. 1). In its essence it summarizes the current problems of construction, architecture, spatial planning and role and place of geodesy – Engineering Geodesy, in their implementation. Thereby, **for the first-time construction activity, architecture, spatial planning and Engineering Geodesy** are considered together **from interdisciplinary viewpoint**, and Engineering Geodesy – as **an integral element** of this complex activity, **in which other specialists play also an incontrovertible role**. The scope, volume, division, structure and content of the single books on the problem are **presented** here. A summary review, analysis and evaluation of the literature in the field of Engineering Geodesy have been made. The original solutions in the system of monographs and the corresponding generalized complex literature are presented. Practically the system of monographs represents a unique digital whole of monograph character with a volume of 2870 computer pages with a uniform numbering of content, text, formulas, figures, tables and reference literature. The analog edition comprises 5 books. This is not found in world literature. Maybe this achievement would be also of interest for the famous “Book of ...”?!





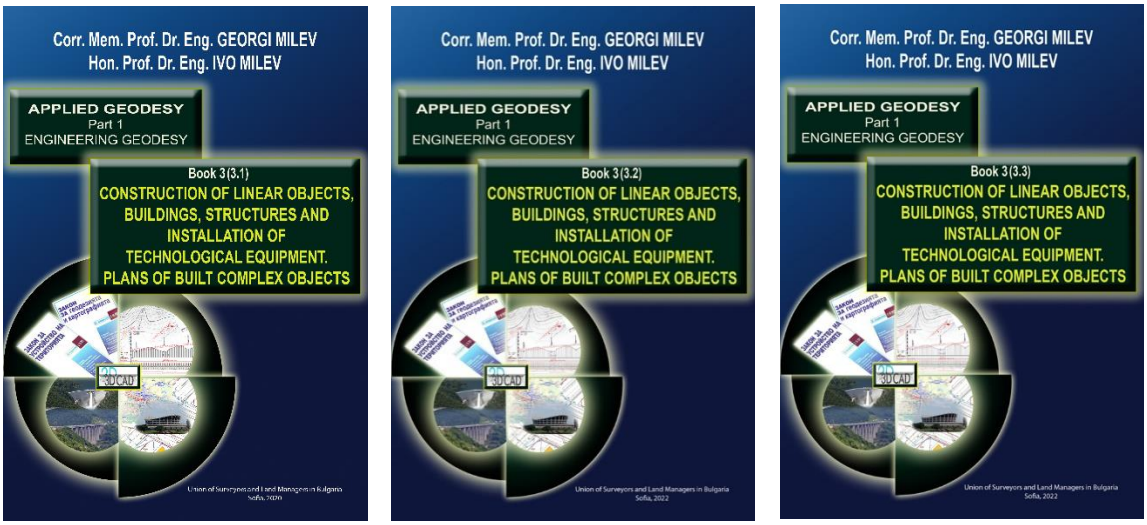


Fig. 2. The five books from the complex monographs on Engineering Geodesy

The problems of the scope, essence and fields of Applied Geodesy and object of Engineering Geodesy were systematized and summarized when presenting Applied Geodesy in [6], as well as in the work "Milev G., I. Milev. Applied and Engineering Geodesy. S. USLMB. G, C, LM. 2017, 1-2. 3-13". In fact, the exposition on Part 1. Applied Geodesy – Engineering Geodesy, is completed with the end of section 13 of [5]. This makes possible the **analysis and comparison** of the position, principles and approach in the generalization, systematization, structuring, content and statement of the problems of Engineering Geodesy and their place in the relevant specialized literature. And at the same time to **specify, precise and clarify** these problems. Unfortunately, all this is missing in the specialized world literature in this area.

The origin of geodesy, as explained in its history, is associated with economic activities in Egypt [28], [18]. Further on this continued with the **emergence**, at a much later stage, of **Engineering Geodesy** – summarizing the geodetic works in this field. It was mainly **related with construction**, with building larger objects, when it was necessary to provide their planar and at a later stage – spatial geometry [9]. Along with the **mass scale** of the activities for construction and operation of the **engineering objects and facilities and spatial planning**, and together with the **development of geodesy**, the volume, nature, requirements, accuracy change, the methods and technologies advance, and Engineering Geodesy develops (including the software) and is increasingly **integrated**, becoming an **indivisible element** at all stages of construction and operation of the engineering objects and complexes of them.

It is also necessary to emphasize that an impetus of the **literature differentiation and evidencing** of Engineering Geodesy are first observed in the former Soviet Union. Then this was transferred to the former socialist countries, including DDR, and in consequence to United Germany, where it acquired enormous development. Engineering Geodesy was also introduced as an organizational unit in the international organizations – FIG (International Federation of Surveyors, 1958) and later in IAG (International Association of Geodesy).

The development of science and practice set new problems to be faced by Geodesy – Applied Geodesy, related to a new type of unusual for geodesy objects (colliders-accelerators, machine engineering, missiles and navigation, medicine, etc.) and activities. Many of them are **unique**, not traditionally mass objects, but with specific requirements in some cases (e.g. accuracy, parts of mm), so that it is necessary to **solve** unique geodetic problems, going beyond the frames of the usual Engineering and Natural Scientific aspects of Applied Geodesy. Moreover, the development and integration of **new physical, geodetic devices, instruments, systems, equipment, technologies, software**, etc., become necessary, which are not based on

conventional geodetic, but on other principles, some emerging recently at the modern stage. The should be included in Part 3 of Applied Geodesy.

Some of the objects and activities, however, are not principally identified with these of traditional mass Engineering Geodesy but they have an engineering nature. Such are, for example, the problems related to machine engineering, automotive industry, aircraft and ship building, robotics, etc. Therefore, they should be referred to Engineering Geodesy. To avoid confusion with the already defined mass – traditional, **Engineering Geodesy**, the above problems should be differentiated in a separate special part of geodesy – **Special Engineering Geodesy**. As already mentioned the Special Engineering Geodesy should comprise the said engineering activities and objects and the others of **engineering nature**. When the problem is related to it, its name – **Special Engineering Geodesy**, should be used. In the other cases only the **name Engineering Geodesy** would be sufficient.

2. ESSENCE OF THE SYSTEMS OF MONOGRAPHS

The necessity of generalizing, structuring and precising the scope and content of Applied Geodesy imposes, in our opinion, the introduction of certain boundaries and clear definitions. In general, three parts of Applied Geodesy are distinguished: **1. Engineering Geodesy, 2. Natural-scientific aspect of geodesy application, 3. Other (non-engineering and natural-scientific) applications of geodesy**.

It is seen that this covers the realization of the versatile application of geodesy without violating the already established division and application. At the same time the first two parts include **mass applications** in the respective areas of knowledge and practice and the third part includes, in principle, **special applications and fields** not falling within the scope of the first ones {cf. also 01.3.2 of [6]}, with **more specific characteristic requirements for Applied Geodesy** and related areas, such as:

- Military affairs;
- Economy branches – related to application in the Cadastre, real estate appraisals, agriculture and forestry, environment, etc.;
- Hydrography – related to water basins: oceans, seas, lakes, river and other water sources and systems;
- Specific applications – meteorology, navigation, broadcasting, urban noise-protection systems and studies, etc.;
- Unique and typical separate objects and activities (colliders-accelerators, missiles, medicine, etc.).

It has been already noted in [5] that the **collection, processing and presentation of information** from the mentioned and other areas in the form of **information systems** [5], [7] are very closely related with the indicated activities. It has been also emphasized that there is certain conditionality and in the division of the presented areas **a sharp boundary cannot and should not be set and it is either not necessary**. There are **activities and decisions** that according to certain indicators may be referred to one or another direction. Methods and technologies from the Natural-scientific aspect are applied effectively and extremely successfully in the Engineering area, for example the Global Navigation Satellite Systems – GNSS and others.

Engineering Geodesy is the most comprehensively developed, widely used and with enormous reference literature of all the three aspects of Applied Geodesy.

In this way, on the basis of professional experience, there is a possibility for sufficiently **systematic, detailed and differentiated exposition of the individual aspects of the Applied and respectively of the specific mass activity in the Engineering Geodesy**. **On the one hand**, there is a systematization of the scope, structure and activities in Engineering Geodesy, in our

case in three main books: **Book 1. Basics, systems and technologies in Engineering Surveying [6]**; **Book 2. Design and implementation of physical and general plans [7]**; **Books: 3(3.1), 3(3.2), 3(3.3). Construction of linear objects, buildings, facilities and installation of technological equipment. Plans of the built complex objects** – individual objects and the facilities along them [5]. **On the other hand,** the exposition covers only the problems representing a direct object of Engineering Geodesy. So, figuratively speaking, the attempt "of an adult to put on his child's clothes" is avoided.

Analysing the realized exposition with a **scope, structure and content** of the Engineering Geodesy it may be established that it is also subordinated to **certain principles, logic and connections**, directly related to those of **construction, architecture and spatial planning**, for example mainly adherence to the principle "from the general to the particular". Moreover, it is implied here that the general solution of the objects, especially those with complex spatial solutions, is realized directly on the basis of a **numerical 3D model** composed **in cooperation** between **architects, designers and surveyors**. In addition, the surveyors provide first of all the axes, levels, coordinates and the designed and realized geometry (for this and other reasons they are also known as "geometers"), ensure also control in the course of construction, installation and study of deformations and, which is very important – initial and other information about the objects (GIS, BIM, etc.). **Undoubtedly, in the interdisciplinary activity of construction and management of the objects, as already mentioned, other specialists have also an indispensable role.**

It is also worth mentioning that in contrast to the **constructors and architects**, the **results of whose activity** are visible – **the built objects**, and which is generally perceived as a public fact, this cannot be said about the **work of the surveyors**, because the practical results of it **are integrated** in those of the constructors and architects. This activity **is known** to a great extent **by the specialists** but the results of it **are not known and are not visible** for the other citizens. It is not only invisible but it is also not directly used. To a certain extent the results of geodetic activity are visible only in vertical planning, cadastre, cartography, etc.

And something else. In fact it can be assumed that the accepted and realized here principles, activities, exposition and general joint representation of construction, architecture, spatial planning and Engineering Geodesy, together with the other activities on the construction and operation of the objects, are a prerequisite and are entirely integrated in BIM as they are presented in {3.12.2.1 of [5, (3.3)]}. This is also a very important aspect that should not be missed or neglected.

So the generalized and systematized exposition of Engineering Geodesy comprises:

Book 1 contains: The essence of Applied Geodesy; the **general problems of construction** as a whole (organization, normative regulation, etc,); the **basics and systems, methods and technologies**, on which Engineering Geodesy is built; their further content and realization.

Book 2 contains, again in accordance with architecture and construction, the **general problems of territories – spatial planning and arrangement, and in particular construction in built-up areas** – the complex of sites (settlements, industrial enterprises, etc.), their nature, design and application (spatial plans – general, detailed, including regulation plans, master plans), comprising and showing the role, tasks, methods, technologies of Engineering Geodesy in their development and implementation.

Book 3 continues already with the consideration of **building** specific types of objects, and here including and presenting also the role, tasks, methods, technologies of Engineering Geology in their realization. Due to the large volume of the exposition Book 3 was formed as 3 **books**: **3(3.1), 3(3.2), 3(3.3).** Moreover, with information and **specific examples from practice** for solving the problems of individual sites, which in our opinion is of special importance.

Book 3(3.1) presents the design, construction, operation and reconstruction of linear objects and the specifics of the geodetic works in railway lines, roads, energy supply structures, communications, water supply and sewerage, cableways, as well as tunnels and metro lines.

Book 3(3.2) includes the problems related to the design, construction and installation of facilities along other linear objects, for example bridges, as well as the geodetic methods and technologies for the tracing and control measurements and study of their deformations. These problems are also considered for hydrotechnical sites, built independently or in engineering complexes – dams, cascades, etc., as well as hydromelioration sites, river corrections, floods and droughts, ports and river transport.

Book 3(3.3) presents the exploration, design, tracing and control and deformation studies during construction, assembly and operation of buildings, industrial facilities and technological equipment, installation of machines of different designation, as well as objects for civil purposes – airports, sports, high-rise structures, etc. Further on the development of plans and modelling of the built sites – BIM and cadastre of communications of complexes of engineering objects and relevant information systems, respectively – Specialized data (model) of underground communications, as well as other engineering aspects of application.

The exposition in 3(3.1), 3(3.2) and 3(3.3) provides first brief up-to-date **specific information** for the **different objects**, about **their nature, construction, requirements, normative base and peculiarities**. So, among other things, the **actual** engineering information and terminology are used and the specialists speak the same language, moreover that the considered problems are **interdisciplinary**.

It has been already mentioned that the material is summarized, systematized and structured and that the content is formulated and the issues of Engineering Geodesy problems considered. In addition, it has been pointed out that the exposition is original and conceived in such manner that practically not only Book 3 but also each section represents a completed independent work – a separate **monograph**. In this way, **a new concept, a new unit in literature** appeared, namely "**Systems of monographs**" or "**System monograph**", for books of such character.

3. SUMMARY REVIEW, ANALYSIS AND EVALUATION OF LITERATURE IN THE FIELD OF ENGINEERING GEODESY

In historical plan there is an **enormous number** of works devoted to Applied and Engineering Geodesy. Some of them are cited in the literature referred to here and in the literature to the separate books and sections and at the beginning of Book 1. In addition, it is appropriate to clearly emphasize that **the beginning and the distinguishing of mass Engineering Geodesy**, its formulation, definition and use as a concept have been set and differentiated in the former Soviet Union. Regardless of the fact that **large-scale projects** with a significant volume of geodetic works, with high accuracy and specific requirements **have been conducted in many other countries**.

It has to be definitely noted that there is a great variety in the type, form of presentation, essence of exposition, structure and other indicators of the works on Engineering Geodesy. Great part of the **literature sources is dedicated to individual problems** of Engineering Geodesy. However, about 90 % of the contents consist in basics and elements of **conventional geodesy** – essence, tools, survey methods, etc., and only the remaining, relatively **small volume** includes the problem of Engineering Geodesy. This was typical for publications mainly from the former Soviet Union and the other countries of the Socialist Block at that time.

Most often **works on geodesy** were written, in which **separate** sections or chapters were devoted to Engineering Geodesy. Some of them are already **complex works**, considering the

problems of geodesy and Engineering Geodesy on a modern level {28], [14]. Due to the lack of sufficient volume, this consideration is often limited or the books are with a large volume. There are also **opposite cases**, when in their greater part the works are dedicated to Engineering Geodesy but they **integrate** parts of general geodesy, geodetic tool development, traditional and unique instruments and technologies [25], problems of mathematics, error theory, etc. [27], [28].

Certain issues of Applied and Engineering Geodesy are considered in an extremely large number of works and they are very comprehensive and on a high level. Earlier this was true for publications in the former Soviet Union. In the last more than 20 years this also holds true for the countries in Western Europe and especially for Germany.

At the same time there is a large number of works in the literature aimed at providing **systematic presentation** of the issues of Engineering Geodesy. Although they consider essential problems of Engineering Geodesy, they can be defined as "fragmentary" ones. Depending on the level and experience of the author/authors the **exposition** is without a definite focus and is often chaotic – in a bulk state, not exhausting the problems. **Others** are on a relatively high level, reflecting the state of science and practice at the given stage of **development** of society. Part of them are in the form of one or several books, for example [1], [8], [2], [3], [11], [12], [13], [22], [23], [24], [15], [16], [26], [30], etc.

The main problem, in our opinion, of almost all works on Engineering Geodesy **issued so far**, is their **detachment** from their genesis, from construction, architecture and spatial planning. As we have already pointed out, the problems solved in the construction and operation of engineering objects and complexes of them are **interdisciplinary**. The geodetic issues here – an element of the Engineering Geodesy, **are also part** of these interdisciplinary problems. It is not a coincidence that instead of Engineering Geodesy, some of them were named (in the XX century, for example in the USSR and in Bulgaria) as **Geodetic Works in Construction** [9] or **Geodesy in Construction** {[4], textbook in 6 editions} or in the former Soviet Union, for example Viduev, G., D. Rakitov **Application of Geodesy in Civil Engineering**. M. Nedra, 1962, 1964, 399. It should not be forgotten that Prof. Bertold Witte from Bonn and co-authors, Germany, entitled the 9th edition of their book **Geodesy for Construction and Basics of Building Information Modeling (BIM) and Statistics** (Vermessungskunde für das Bauwesen mit Grundlagen des Building Information Modeling (BIM) und der Statistik [28]) regardless of the content and way of exposition.

In fact, there are few **full and systematic and comprehensive serious modern presentations**, devoted directly to the issues of Engineering Geodesy in the specialized world literature. Here only **two of them** will be discussed for comparison, issued recently in Germany, juxtaposed with the stated by us settings and solutions, together with the publications of Prof. Bertold Witte and co-authors. Our attitude towards them is an undeniable respect and high estimation, regardless of our criticism in some aspects, moreover that our works in this field, including dissertations, have been developed and published in Germany.

In one of the expositions, the presentation and division of the problems of Engineering Geodesy is related to works [19], [20], [21], [22]. Initially this presentation (there are also subsequent amended editions) is **realized** in single parts – **books, differentiated** mainly according to the available authors and their books in the area of Engineering Geodesy.

The other exposition, presentation and division of Engineering Geodesy [25] (part of the last analog of the Jordan Eggert und Kneisel – http://www.springer.com/series/15072 edition [29]) contains 17 sections. Great part of them (~ 8) are related to the description of principles, unique devices and measurement technologies with them.

Otherwise, in the interest of objectivity, as already mentioned, both considered publications are undoubtedly of the highest class in every other respect, especially in terms of

relevance, vanguardness and quality and can only be admired. We consider that such an estimation deserves also the publication of Prof. B. Witte and co-authors [28]. In our opinion, with certain addition, extension and focus only on Engineering Geodesy, it would also cover to a great extent its issues.

4. ORIGINAL SOLUTIONS IN THE SYSTEMS OF MONOGRAPHS

1. A new concept is introduced in the literature – System of Monographs – System Monograph;

2. Summary, systematization, classification, structuring and exposition of Applied and Engineering Geodesy according to a certain principle. Practically this is missing so far;

3. Distinguishing of the material in three parts: 1. basics, systems and technologies, 2. complex of objects and 3. individual objects;

4. Presentation of the material in 5 books {due to the large volume of the material included in Book 3 it is printed in three books 3(3.1, 3.2 and 3.3)} with a uniform numbering, contents and as a united digital edition of Part 1. Engineering Geodesy (over 2870 computer pages);

5. There is a planned, direct and inevitable connection of the considered matter and its concrete realization in the books of 1. Engineering Geodesy – a unified organic entity;

6. Uniform structuring of the individual sections;

7. Detailed interdisciplinary joint presentation of the current state of the individual objects, normative regulations and type, volume, nature and specifics of the geodetic works;

8. Development and application of an original sequential multiple (triple) four-level numbering of contents (up to 3 levels), figures, tables, citing;

9. Introducing the normative base for all objects;

10. Providing many particular examples from practice for the considered objects;

11. Composed with a multitarget purpose – science, education, application (practice);

12. The implemented here principles, exposition and summarized joint presentation of construction, architecture, spatial planning and Engineering Geodesy are a prerequisite and are entirely integrated in BIM, which is the desired perspective;

13. Maybe with the stated parameters it could be of interest for the known "Book of..."?!

5. CONCLUSION

The modern development and achievements of science and practice are reflected effectively in Applied, respectively Engineering Geodesy and hence also in the interdisciplinary application (realization) in that of construction, architecture and spatial planning. The interdisciplinary, comprehensive joint treatment of the problems is also of substantial importance and it has to find its reflection in the specialized literature dedicated to these issues. The proper joint summarizing, systematization, structuring and presentation are of special significance for the further progress in this field of knowledge.

In their exposition the authors, along with the aspiration for keeping the general moral principles have brought to the fore the correctness, confidence and mutual respect (esteem) of other authors. And in unison with the motto of the books: "*Science demands from man his whole life. And if you would have two lives, they would not be sufficient. Science requires from one high strain and great passion"* {Acad. Ivan Petrovich Pavlov (1849-1936), Nobel laureate, https://psichov.net/pavlov-ivan-petrovich/}

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5.2. COSMIC AND GEO-SPACE TECHNOLOGY WITH APPLICATION TO ENGINEERING GEODESY

Bulgarian Academy of Sciences. Space Research and Technology Institute.
Aerospace Research in Bulgaria. 35, 2023, Sofia

New5 Books - Systems of Monographs

COSMIC AND GEO-SPACE TECHNOLOGY WITH APPLICATION TO ENGINEERING GEODESY

After nearly nine years of work the volume of 5 books Applied Geodesy – Part 1 Engineering Geodesy, was completed (2022). Each of them represents a **system of monographs (totally 2870 computer pages)**. In its essence the work summarizes the contemporary problems of construction, architecture, spatial planning and the role and place of geodesy – Engineering Geodesy, for their realization. In this way, **for the first time, construction activities, architecture, spatial planning and Engineering Geodesy** are considered together from **an interdisciplinary viewpoint**, and Engineering Geodesy also as an **indivisible element** of this complex activity, **in which other specialists and especially geospatial technologies play also an undeniable role**.

Geospatial systems, devices, methods and technologies are an important prerequisite and means of special significance in many areas of modern knowledge and its application. They are widely used at the different stages related to the exploration, design, construction and operation of the engineering objects and complexes of them. Generally, the technologies are:

1. Space and aerial Geospatial Technologies

- Global navigation satellite systems for positioning – GNSS)
- Satellite remote sensing systems – photogrammetric, laser, radar, radar interferometry, DinSAR, etc.;
- Photogrammetric, laser and other sensor systems and technologies for aerial photography, including oblique photographs (Pictometry), aerial laser scanning of terrestrial and underwater surface and other applications;
- Spatial visualization and modelling of urbanized areas.

2. Terrestrial Geospatial Technologies

- Randomly selected station – spatial photo and tracing by an electronic tachymeter;
- Photo, tracing, control, management of construction machinery;
- Integrated systems – electronic tachymeter + GNSS;
- Laser scanning – photo, documentation, control;
- Other specialized technologies, e.g., based on the use of sensors and sensor systems.

3. Collecting, processing and presenting information using the mentioned and other areas in the form of information systems.

4. Use of Specialized Software

It is clear that the Geospatial Technologies are interdisciplinary, with a wide scope, possibilities, importance and application areas.

The emphasis in the reviewed books is laid on the application of* Geospatial systems, devices, methods and technologies in *architecture, construction and spatial planning through Applied – respectively Engineering Geodesy.

The bibliographic description of the books is as follows:

Milev, G., I. Milev. Applied Geodesy. Part 1, Engineering Surveying. Book 1. Basics, Systems and Technologies in Engineering Surveying. Sofia, USLMB. Avangard Publ. House. 2017. 498 p.

Milev, G., I. Milev. Applied Geodesy. Part 1, Engineering Geodesy. Book 2. Design and Implementation of Physical and General Plans. Sofia, USLMB. Avangard Publ. House. 2017. 330 p.

Milev, G., I. Milev. Applied Geodesy. Part 1, Engineering Geodesy. Books 3(3.1); 3(3.2); 3(3.3). Construction of Linear Objects, Buildings, Structures and Installation of Technological Equipment. Plans of Built Complex Objects. Sofia, USLMB. Avangard Publ. House. {Books 3(3.1), 2019. 524 p.; 3(3.2), 2022, 530 p.; 3(3.3), 2022, 466 p.}.

Data about the considered books are given in the following plate:

The problems treated in the books are:

Book 1 considers the fundamentals of Engineering Geodesy – the modern investment process, legal framework, geodetic base (digital data, plans, maps and reference networks), instruments, devices and systems; reference and coordinate systems and surfaces, theoretic bases of geodetic measurement processing, algorithms and software, **modern numerical geospatial technologies and their application in Engineering Geodesy and information systems, related to it**. The main problems of tracing are presented: essence, elements, methods, technologies, accuracy, norms and case studies; theoretical bases and practice in the control and determination of displacements and deformation studies of engineering objects, including landslides.

Book 2 treats the interdisciplinary problems related to physical planning – spatial schemes, physical and general plans of complexes of objects – industrial enterprises, airports, etc., together with the role of geodesy and the contribution of surveyors to their realization. The main emphasis is laid on the technology of design and implementation of regulation plans, general (master) plans and vertical planning schemes. Moreover, the problems are treated from an interdisciplinary viewpoint, as well as from the position of modern capabilities of: digital design, geospatial technologies, use of **global satellite navigation systems**, electronic systems for measurement and data processing, tracing and control, **geoinformation systems**, use of modern digital cadastre, etc.

Books 3 continue further considering the **construction** of specific types of objects, including also the role, tasks, methods and technologies of Engineering Geodesy in their realization. Due to the large volume of the exposition Book 3, as already mentioned, is formed in 3 **books: 3(3.1), 3(3.2), 3(3.3).** Moreover, with information and **specific case studies from practice** for solving the problems of single objects, which is in our opinion of extreme importance.

Book 3(3.1) treats the design, construction, operation and reconstruction of linear objects and the specificity of geodetic works for railway lines, roads, facilities of electric supply, communications, water supply and sewerage, rope lines, as well as tunnels and metro lines.

Book 3(3.2) includes the problems related to the design, construction and assembly along other linear objects, e.g. bridges, as well as the geodetic methods and technologies for tracing and control measurements and deformation studies. These problems are also presented for hydrotechnical objects, built independently or in complexes of engineering structures – dams, cascades, etc., as well as hydromelioration objects, corrections of rivers, floods and droughts, ports and river transport.

Book 3(3.3) presents the exploration, design, tracing and control, and deformation studies in the construction, assembly and operation of buildings, industrial facilities and technological equipment, installation of various machines, as well as objects for civil purposes – airports, sport and high-rise facilities, etc. The composition of plans and the modelling of the built objects is presented further on – BIM and the communication cadastre of the complexes of engineering objects and the corresponding information systems, respectively Specialized data (model) of underground communications, as well as other engineering aspects of application.

Undoubtedly, such a vast matter cannot be comprehensively presented in all its aspects. In the structuring of the books and the exposition, a balance is sought in representing the main problems and an accent is laid on the aspects that are more directly related to the activity of surveyors in the field of spatial planning and geospatial technologies.

The books have an original structure. The exposition is in compliance with current legal framework and the possibilities offered by modern digital devices, instruments, systems and technologies. The books reflect to a great extent the views, long-term research, lecturing experience and participation in the construction and study of engineering objects, including original spatial structural solutions of the authors. The applications refer to specific real objects.

The books can be used by lecturers, students and practicing specialists in the area of architecture, construction, spatial planning and surveying – Engineering Geodesy, and all those who work in the field of construction and operation of engineering objects and complexes of them, such as architects, structural engineers – constructors, spatial planners and specialists on transport, water works, etc., designers, contractors, experts on organization and control of construction and installation of technological equipment. It is definitely recommended, if necessary, to do this using simultaneously all the five books.

Some original solutions in the systems of monographs are:

1. A new concept is introduced in literature – System/s of monograph/s – A system monograph;
2. The matter is distinguished in three groups: [1. Basics, systems and technologies, 2. Complex of objects and 3. Individual objects (three books)]; 4. Development and application of original, subsequent multiple (triple) four-level numbering of contents (up to 3 levels), figures, tables, citations; 5. Giving a large number of specific examples from practice for the considered objects; 6. The principles, exposition and generalized joint representation of construction, architecture, spatial planning, Engineering Geodesy, implemented here, are prerequisites and fit in BIM, which is the desired perspective.

The assessment of the single books and of all five books as a whole, dedicated to Engineering Geodesy within the frame of Part 1 of Applied Geodesy with an emphasis on the geospatial technologies, made by the reviewers of the edition and by the users, is extremely positive and superlative. Such evaluations are for example – systematization, generalization and complex original presentation that have not been found so far in world literature; unique work; “book of books”; the exposition is from an interdisciplinary viewpoint and for a broad circle of users with various professional and scientific interests; with original contributions to science and practice and many others.

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5.3. OTHER REVIEWS AND FEEDBACK

For the individual books and the work as a whole, there is a very large number of reviews, feedback, e-mails, websites, etc. available. Most of them are published mainly in the Magazine "Geodesy, Cartography, Land Management".

Sofia, 12.03.2023 The authors.

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