N. M. Belyaev

Strength of Materials

ИЗДАТЕЛЬСТВО МИР

Н. М. БЕЛЯЕВ

СОПРОТИВЛЕНИЕ МАТЕРИАЛОВ

ИЗДАТЕЛЬСТВО «НАУКА» МОСКВА

N. M. BELYAEV

Strength of Materials

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Nikolai Mikhailovich Belyaev (1890—1944)

Nikolai Mikhailovich Belyaev occupied a leading position among eminent Soviet scientists who worked on the technical application of theory of elasticity and strength of materials and structures.

After graduating from the St. Petersburg Institute of Railway Engineering in 1916, Nikolai Mikhailovich Belyaev was invited to stay at the Strength of Materials Department, where he worked under S. P. Timoshenko.

Nikolai Mikhailovich Belyaev was associated with this institute (now the Leningrad Institute of Railway Engineering) throughout his life. At the institute he taught subjects like engineering structures, bridges, theoretical mechanics, strength of materials and theory of elasticity, and from 1924 to the end of his life was Head of the Strength of Materials Department.

All his life Nikolai Mikhailovich Belyaev was a leading engineer and research worker. He was the first to formulate and solve the problem of stability of prismatic bars under variable axial loading—a problem interesting from the theoretical aspect and important from the point of view of applications. Simultaneously, Nikolai Mikhailovich Belyaev worked on the problem of local stresses in bodies in contact under compression. Here he considerably developed the works of Hertz. The work first published by Nikolai Mikhailovich Belyaev in 1924 has completely retained its value to this day.

In the Soviet Union Belyaev was one of the first to undertake the study of the theory of plastic deformation, and he contributed a lot towards the development of this field.

Nikolai Mikhailovich Belyaev spent the last years of his life in fruitful research on problems of creep and relaxation of metals under high temperatures.

Nikolai Mikhailovich Belyaev was a rare talent who successfully combined theory with experimental research. In 1924 he took over as Head of the mechanical engineering laboratory of the Leningrad Institute of Railway Engineering, and in the course of 16 years of administration changed the laboratory into a leading scientific research centre.

New technical specifications ensuring long and reliable performance of rails were compiled as a result of the research conducted at the laboratory under the guidance and with direct participation of Nikolai Mikhailovich Belyaev. These specifications with minor additions are in force to this day.

Research done by Nikolai Mikhailovich Belyaev in the field of technology of concrete won wide acclaim all over the Soviet Union.

The pedagogical activity of Nikolai Mikhailovich Belyaev was not restricted to the Leningrad Institute of Railway Engineering. He worked at the Leningrad Technological Institute (1919-1926), Leningrad Institute of Civil Aviation (1931-1934), and from 1934 onwards was Head of the Strength of Materials Department at the Leningrad Polytechnical Institute—the biggest institute in the country.

In 1939 Nikolai Mikhailovich Belyaev was elected Corresponding Member of the USSR Academy of Sciences, and from 1942 occupied the post of Deputy Director of the Institute of Mechanics of the Academy of Sciences of the USSR.

His book *Strength of Materials* has won wide recognition in the USSR.

Preface to the Fifteenth Russian Edition

The new edition of *Strength of Materials* by N. M. Belyaev has been published after 11 years. In 33 years that lapsed between the publication by N. M. Belyaev of the first edition in 1932 and the last fourteenth edition in 1965 a total of 675 000 copies of the book were sold, testifying to its wide popularity. During this period the book was periodically enlarged and revised by N. M. Belyaev and, after his death in 1944, by a group of four of his co-workers. This group, which prepared from the fifth to the fourteenth editions for publication, did not consider it proper to make substantial changes in the original work of N. M. Belyaev. Additions were done at one time or another only when they became absolutely necessary due to changes in standards and technical specifications and in the light of recent research.

In the present edition, prepared by the same group, a number of topics have been dropped either owing to their irrelevance to strength of materials or because they are rarely taught in the main course. The topics that have been dropped include Contact Stresses, Riveted Beams, Reinforced Concrete Beams, Approximate Methods for Calculating Deflection of Beams, Beams on Elastic Foundation, Design of Thin-walled Bars, all graphical methods, and a part of Complicated Problems of Stability Analysis, the other part of the last topic being presented in an abbreviated version. The reader may refer to the earlier editions of this book or special monographs in case information is required on these topics.

Considering the availability of a large number of problem books (see, for instance, *Problems on Strength of Materials* edited by V. K. Kachurin) on the market, most of the examples have been dropped from the present edition. Only examples that are essential for the explanation of theoretical part have been retained.

For greater compactness the problem of design for safe loads has now been included in Chapter 26. For the first time the chapter includes the principles of design for limiting states, which though beyond the limits of the basic course of strength of materials are important enough to require an exposition of the basic concepts even at this stage of teaching.

The problems of strength, which in the previous editions occupied two chapters, have been grouped into one. The part dealing with actual stresses has been transferred to Chapter 2, where it has been presented in a sufficiently detailed manner.

The tables containing data on materials have been dropped from the appendices. A part of the data on materials has been transferred to corresponding sections. The obsolete steel profiles grading has been replaced by new ones.

As in the previous editions it was our endeavour to preserve Belyaev's style and method of presentation of material. Therefore the author's text has in general been preserved. If Nikolai Mikhailovich Belyaev were alive today he would possibly write many things in a different way. However, since the book won wide popularity as written by N. M. Belyaev, we tried to preserve the original text as far as possible.

The work involved in preparing the fifteenth edition for publication was distributed among the group as follows: Chapter 13, § 80 of Chapter 14, Chapters 15-19, 24-25—L. A. Belyavskii; Chapters 6, 8-12, 27-28—Ya. I. Kipnis; Chapters 1-5, 26 and appendices—N. Yu. Kushelev; Chapter 7, § 79 of Chapter 14, Chapters 20-23, 29-32—A. K. Sinitskii.

A. K. Sinitskii

March 1976

Contents

PART IV. Bending. Strength of Beams

PART V. Deformation of Beams due to Bending

PART VI. Potential Energy. Statically Indeterminate Beams