November-December 2019
ISSN: 0193-4120 Page No. 1863 - 1868

Analysis of the Scientific Directions and Methods of Forming University Courses on the Example of Classical Hydraulics

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Article Info
Volume 81
Page Number: 1863 – 1868
Publication Issue:
November-December 2019

Abstract
Introduction: it is proposed to define the boundaries and content of modern University course by multivariate statistical analysis of the distribution of the volume of material in different sections of the subject field in monographs, textbooks, scientific articles and reports.

Methods and materials: to substantiate the impact sections monographs on total hydraulics used mathematical probability theory. Provides confidential assessment percentage content of 30 sections in a statistically average course construction hydraulics.

Results: the composition of the sections analyzed University course that best matches the development of science and technology. Illustrates the relationship of sections in various publications between them arising from the results of correlation analysis.

Conclusion: the method of evaluating the significance of sections in the total amount of the course and their mutual impact on the overall course content.

***Keywords**: sections of content publication, correlation coefficient, confidence interval, multivariate statistical analysis, external schema, conceptual schema.*

Article History
Article Received: *5 March 2019*
Revised: *18 May 2019*
Accepted: *24 September 2019*
Publication: *10 December 2019*

I. Introduction

Design and construction in modern conditions requires extensive knowledge in various fields of science and technology, which are set out in University courses. Thus, the course of fluid mechanics should contain the basic data of technical fluid mechanics, their structure and semantics, and would ensure the activity of these data in the process of teaching students and designing engineering networks and structures in construction by engineers and researchers. Therefore, the course should include modern and necessary for designers and builders' sections, the allocation of which is the most important and complex tasks of teaching in high school. This article is devoted to the solution of this problem.

Instead of the course analyzed in the article, the modern composition of any other University discipline can be determined.

The development of University courses, in this article classical hydraulics, will occur in areas less related to hydraulic structures, water supply and sanitation, and more with computerization, numerical methods, management issues, and so on. What has repeatedly drawn the attention of the country's leadership. The teaching of University courses in higher education institutions should undergo changes necessary for development in these areas. Consequently, the content of textbooks, manuals and courses of lectures and the writing of new ones will change.

The proposed scientific article is the first attempt in which the analysis of changes in the development of science, and, consequently, in different courses. It analyzes the content of the course as of today and gives the composition of the ideal course on the basis of research teaching of 27 prominent scientists. Textbooks are compiled by the authors in order to increase the readiness of students, postgraduates and masters, as well as to contribute to the improvement of engineers.

Further development of the proposed work should be devoted to changes in the course caused by new trends of modernity. They are due primarily to the widespread introduction of computers, the removal of data in real time, the use of data from satellites and will lead to serious changes in the course of hydraulics. Making changes in courses, and not only in them, is the main task of teachers, set in the may presidential decrees, so that the training of our students, masters, graduate students corresponds to modern trends in the development of science in the world.

Each science should have points of growth, which are new problems of engineering practice and the development of appropriate theories, models and methods for their solution. So, the boundaries of hydraulics as a science are largely blurred due to the fact that the need for the use of its laws and methods arises in various fields of human practice: in construction, in engineering, in mining, in metallurgy, in agriculture, etc. In addition, the boundaries of hydraulics with other Sciences cannot always be clearly drawn.

Hydraulics should grow with the development of science and be able to be supplemented by knowledge of specific proposals. At the same time, in the process of presenting hydraulics, it is necessary to know which sections of science should be necessarily presented in the course and in the first place, and which can be added to interested listeners.

The volume of the presented material containing knowledge in volume, structure and in the ratio satisfying the majority of trained, we will call a standard set of sections of a course of hydraulics.

II. Methods and materials

The boundaries and content can be determined by analyzing the literature: textbooks, manuals, monographs, reference books, abstract journals, etc. on the studied course. In the same way, the necessary detail of the presentation of the material of certain sections is estimated.

The knowledge of hydraulics required for specific applications is determined by the literature of specific subject areas. For example, there are many monographs with mixed and concretizing titles: "Hydraulics and hydrology", "Hydraulics and hydraulic machines", "Hydraulics of open channels", etc.

This method of determining the boundaries and content can be justified primarily by the fact that the authors of monographs, calling their work Hydraulics, certainly sought with varying degrees of detail, determined by the number of allocated plans for the publication of printed sheets, to highlight their science and best meet the needs of readers: students, design engineers, researchers. Therefore, any monograph with the title "Hydraulics" is a view of the scientist (author) on the structure and content of the subject area, that is, a kind of external scheme of hydraulics.

As a result of the analysis of many external schemes of hydraulics the scheme of hydraulics describing statistically average monograph can be constructed, and the contents with its conceptual scheme will correspond to it.

To determine the content and proportions of the statistically average monograph on construction hydraulics, 30 sections were allocated in the

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subject area and 18 monographs with the title "Hydraulics" were analyzed, recommended as textbooks, manuals and manuals for students and engineers of construction specialties [1] - [18].

These monographs belong to scientists of various hydraulic schools, so it can be argued that the sample is random.

In the process of analyzing the content of monographs for each section, the relative volume was determined, that is, what part of the total number of pages of the book are pages devoted to the material of the section. These data formed a matrix of observations in ECM which the monographs are experiments and the sections are factors. As a result of processing the matrix on a computer program multivariate analysis was obtained table of correlation coefficients. For each section, the mean value, standard deviation, second – fourth moments are determined and the hypothesis of normality of the distribution is tested.

The selected sections of hydraulics and confidence estimates of their percentage in the statistically average monograph with a reliability of 0.95 are given in table 1.

№		Name of section	Trust assessment of the percentage of the content	Confidence interval
1		The basic physical properties of the liquid	1.39	± 0.21
2		Hydrostatics	8.04	± 0.96
3		The equation of continuity, and D. Bernoulli	9.28	± 0.98
4		Hydraulic resistance	12.08	± 1.08
5		Steady-state fluid flow in pressure lines	4.34	± 0.49
6		Leakage of liquid from holes and nozzles	5.14	± 0.44
7		Uniform fluid motion in open channels	4.75	± 0.55
8		Unsteady movement of liquid in pressure	2.29	± 0.36
9		pipelines. Waterhammer.	7.39	± 0.84
		Uneven fluid motion in open cylindrical	1.3	±
10		channels. Hydraulic jump.	0.29	0.35
11		Modeling of hydraulic phenomena	1.86	
12		Dynamics of viscous liquid. The Navier-Stokes	1.08	± 0.59
13		Equation	6.52	± 0.24
		The potential motion of a fluid	1.44	±
14		Uneven fluid motion in open non-cylindrical	1.39	0.54
15		and natural channels	5.46	± 0.25
16		Weirs	1.08	± 0.34
17		Hydraulic calculation of waterworks	1.27	± 0.84
18		Hydraulic calculation of mating structures	0.65	± 0.26
19		The steady-state flow of groundwater		
20		Hydraulic jets	0.81	
21		Unsteady fluid motion in open channels	1.09	
		Gates (outflow from under the shield)	0.31	± 0.22
22		Calculations of the coupling of the jet with the	0.09	± 0.4
23		flow in the downstream of the hydraulic	1.0	± 0.13
24		structure	0.55	
25		Fluid flow around bodies	0.84	
26		Hydrotransport	0.88	

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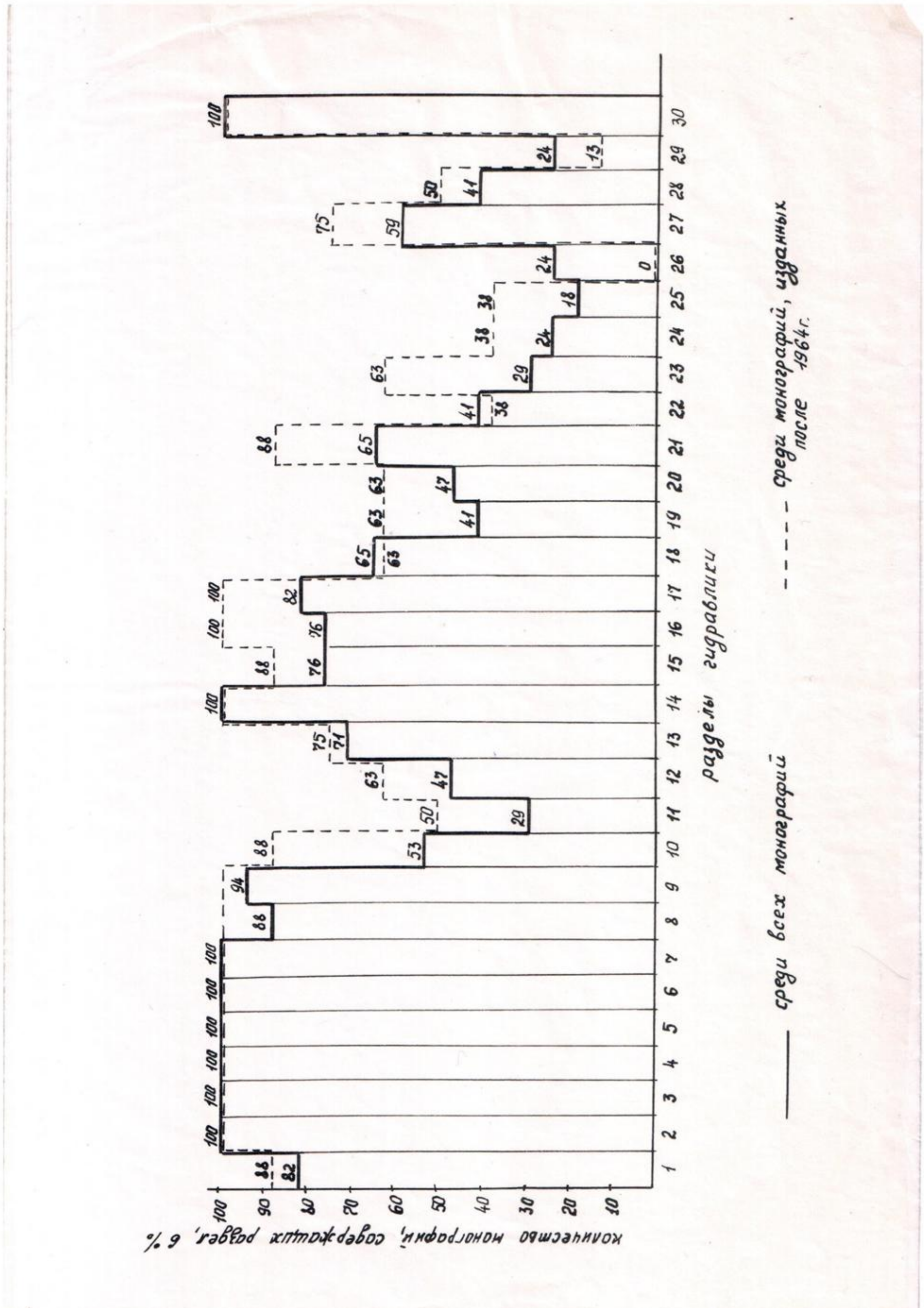
27 28 29 30		Cavitation Elements of the theory of wind waves Filling of tanks and reservoirs Fluid flow with variable flow rate Suspended flows. The movement of sediment Gateways calculation Other questions of hydraulics theory and practice	0.96 14.61±	 ± 0.33 ± 1.67

Table 1.

The number of monographs containing these sections is shown in Picture 1.



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Section 30 of the list includes questions of the history of hydraulics, hydrodynamic theory of lubrication, hydraulics of non-Newtonian fluid, turbulence theory, unsteady movement of groundwater, the use of computers in hydraulics, calculations of locks, rafters, channels with ice cover, as well as the planned problem of steady non-pressure fluid movement. These questions are considered only in one or three monographs out of seventeen.

The results of statistical calculations show that for the data of eight sections (11,19,20,24-27,29) the hypothesis of normality of distribution is not valid. This suggests that the authors of the monographs do not have a consensus on the need to include these sections in the course of hydraulics, as well as on the relative volumes allocated for them. For the listed sections, confidence intervals are not given in the table.

The confidence intervals for sections 6 and 14 were determined after discarding the data from the monograph by Bakhmetiev B. A. [3], where a significant part of the book is devoted to these sections.

III. Results.

The results of the correlation analysis well illustrate the thematic relationship between the sections of hydraulics. For example, the correlation coefficient r6, 14, sections 6 and 14, equal to 0.88, indicates that the content of the sections "the Flow of liquid from the holes and nozzles" and "Weirs" is interrelated: with the increase in the volume of one of the sections, the volume of the second section increases. The same correlation between some other sections of the course:

r16, 22 =0.81, r16, 21=0.72, r20, 21=0.69, r19, 28 =0.67, r19, 26 =0.79, r15, 24=0.61.

At the same time,the correlation between non-traditional sections of hydraulics

(r24, 27 =0.76,r24, 29 =0.79,r27,29 =0.84 r11, 21 =0.64) indicates that if the author of the monograph pays attention to one non-traditional section, he usually does not forget about the rest.

Negative correlation coefficients: r2, 13 = -0.81, r4, 13 = -0.63, r8, 22 = -0.65, r2, 28 = -0.74, r3, 28 = -0.6, show that the increase in the volume of the corresponding sections of the course of hydraulics is due to each other.

Geometrically, any course of hydraulics can be represented as a point in the thirty-dimensional (in our case) space of sections on the hyperplane, cutting off from the coordinate axes segments equal to one. All considered monographs form on this hyperplane some scattering ellipse, inside of which there is a point S, which corresponds statistically to the average monograph.

The distances from point S to other points determine the proximity of the hydraulics courses of authors to the statistical average. These distances (according to Euclid) are presented in table 2.

Table 2

monograph	Distance from S
Chugaev R. R. 14	8.3
Shterenliht D. V. 17	9.3
Konstantinov Yu M 8	9.6
Pincus A. A., E. A. Chugayev 13	9.8
Gusev, A. A. 18	10.1
Evreinov V. N. 5	10.5
Latyshenko A. M., Lobachev V. G. 9	10.7
Bogomolov A. I., Mikhailov K. I. 4	11.5
Agroskin I. I. et al 1	11.5

Akhutin A. N., Zheleznyakov G. V. 2	11.8
Mostkov M. A. 11	12.4
Izbash S. V. 6	14.1
A. Teplov, V. 12	15.6
Kiselev P. G. 7	16.4
Forchheimer F. 16	17.1
Makkaveev B. M., Konovalov I. M. 10	18.9
Peshl Vol 15	21.6
Bakhmetev, B. A. 3	26.2

IV. Conclusion.

1. The boundaries of hydraulics as a science are mostly defined. Sections 1-9, 14-17, representing 70 percent of the statistically average monograph volume, are included in 75 percent of all books and in almost 100 percent of books published before 1970.

2. The monograph of Chugaev R. R. [14] is the closest to the statistically average rate of hydraulics

3. From Fig.1 it follows that the greatest attention in recent years in hydraulics has been paid to research in the field of sections 10, 19, 16, 21, 23, etc. Some sections (26, 29), apparently, in the future will move from hydraulics to special disciplines.

4. Sections 1-9, 14-17, 13, 21, 10 and 27 of the statistically average courses and their relative volumes can be taken as a basis in building a knowledge base of hydraulics. Further expansion of the content of hydraulics should be carried out by successive inclusion of sections 12, 18-20, 23, 11, 28, etc.

5. The proposed method of analysis of the course of hydraulics can be used for the analysis of any University course.

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