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TEACHING FUNDAMENTALS OF MACHINE DESIGN IN ENGLISH

Summary. The paper summarises the good and bad experience that has been collected by the author during more than dozen years of teaching Fundamentals of Machine Design in English for both foreign and Polish students. The most acute problem consists in the lack of teaching aids to the course. The author presents a coursebook to the Fundamentals, which might be useful to all those involved in this type of instruction. Typical problems in the instruction process resulting from a different approach to the course in Polish and foreign universities are also discussed

Keywords: teaching in a foreign language, English as a medium of instruction, coursebook

NAUCZANIE PODSTAW KONSTRUKCJI MASZYN PO ANGIELSKU

Streszczenie. W artykule przedstawiono doświadczenia (dobre i złe) z ponad 12-letniego okresu nauczania podstaw konstrukcji maszyn w języku angielskim zarówno dla studentów zagranicznych, jak i polskich. Największym problemem jest brak pomocy dydaktycznych do przedmiotu. Autor przedstawia książkę do wykładu, która może być pomocna dla wszystkich zaangażowanych w tego typu nauczanie. Przedstawiono również typowe problemy w nauczaniu wynikające z odmiennego sposobu realizacji przedmiotu na naszych uczelniach i uczelniach zagranicznych.

Słowa kluczowe: nauczanie w języku obcym, angielski jako język wykładowy, książka do wykładu

1. INTRODUCTION

Many teachers involved with bilingual teaching gave account of the experience gained. Most of them, however, discuss this type of education in secondary schools e.g. [1] where all students speak their native language. More useful information can be obtained from university researchers involved with the internationalisation programmes. Conclusions are not always positive. Jochems [2] claims that these programmes will reduce the quality of education: “Not only should a considerable drop in study results be expected, but also an increased workload for students and teachers”. Similar conclusions can be found in [3]. This notion is in the author’s opinion, questionable. Polish students who decided to study in English are usually good ones and strongly motivated. The Dean’s Office is not so strict with minimum quotas for

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the number of students in a design class, which is beneficial to the level of instruction. Moreover, the Bologna agreement aims at the harmonisation of the educational systems in Europe and increased mobility of students. As a result, the number of foreign students visiting Wrocław University of Technology for a short period of time (Erasmus) or for the whole programme has progressively increased since the launching of the English Programme some seven years ago.

There is an urgent need for teaching aids supporting the courses taught. English textbooks are scarce and expensive, there are multiple problems with terminology, symbols and last but not least, with a different level of students registering for courses offered in this programme. (Our universities are lax in terms of prerequisite requirements, a practice that is unacceptable for any university following strict registration rules.)

The Department of Mechanical Engineering at Wrocław University of Technology offers now a full program in English. The programme was targeted primarily for those Polish students who were willing to learn technical English. At the current moment foreign students prevail. They come from Germany, Spain (mostly), Portugal, China, Nigeria, Ghana, Saudi Arabia. Individual students visited the University from Italy, South Africa, Finland, U.K., Russia, Switzerland, Turkey and other countries. Many of them are ascendants of their Polish parents, some of them speaking hardly Polish.

The Fundamentals of Machine Design course at the Department of Mechanical Engineering of Wrocław University of Technology is a two-semester course (2 + 2) supported by two-hour concurrent design classes and a laboratory class.

The purpose of this paper is not to answer fundamental questions of teaching in a foreign language or to provide a comprehensive set of good-practice rules. It is limited in scope to a summary of the author's own experience, gained both at the University of Benghazi, (former Garyounis University) and during participation in the English Programme offered by Wrocław University of Technology. The paper discusses language problems, teaching aids offered to students; it mirrors the current situation and plans for the future.

2. ENGLISH LANGUAGE ISSUES

Whether or not one believes that English is "threatening Europe" with linguistic homogeneity, it remains the case that dominant social representations attribute every virtue to this language (for use, communication, the new technologies, etc) and thus contribute to disseminating an ideology of monolingualism...English therefore not only plays the role of a language of communication but is also valued for itself as the language of a model of life or society [4].

Teaching in English is a challenge to a teacher: it must be understood that English is the language of instruction and not the subject matter of the course. Teachers and students shall be considered as peers in this respect. Some of the students speak better English than their instructors (which is, to a degree, a stressing experience; even if the author was confronted with this situation on a few rare occasions), most of them, however, are less proficient. Many of them (especially those coming from Spain) speak very bad English, if at all. A conclusion, also found in many papers, is that a teacher shall purposely (if able) limit his/her language proficiency for the sake of better comprehension. It may be expressed in terms of the comprehension index, a spoken equivalent of a so called readability index. (The American army will not accept an instruction for which this index is higher than 7, i.e. it must be understood by a soldier with the grade school level of education; technical writings have this

value close to 20.) The rules of readability/comprehension stress the use of simple words instead of more complex, less phrasal expressions and idioms.

If the mastering of English is equally important as the subject matter of the course, a practice implemented in many Middle-East Universities may be advised. After a massive transfer to Arabic in the early 90-ties of the previous century, the policy is now to offer a few courses in English to all students of the Faculty, rather than to teach all courses in English for a selected group of students.

Finally, the number of teachers capable of undertaking the task of teaching in English is still small. The author instructs the same students for three of four semesters (Engineering Drawing, then Fundamentals in their different forms). Students petrify pronunciation mistakes of the teacher. After so many hours together, the teacher's judgment is, sort of, biased. Bigger diversity in this respect would be advised.

3. TEACHING AIDS

Unfortunately, textbooks in English on Fundamentals of Machine Design available in the Faculty library are scarce and those in a bookstore, very expensive. This situation prompted the author to prepare some kind of teaching aids. In the early years of the programme, students were given hand-outs for each lecture. With the growing experience, the author decided to collect all those hand-outs into one book which was finally completed in 2010 and made available on the Internet [5] as part of the DBC (a digital library).

3.1. The structure of the Coursebook

Why a coursebook and not a textbook? The idea was to provide students with a book that will help understanding the lecture in the class and not a book that is used for self-study at home. The coursebook was designed and written to support the learning process in the Fundamentals of Machine Design course. It was therefore limited and dedicated to topics included in the syllabus of the course only. The arrangement of lectures was also governed by assignments offered concurrently in the design class and experiments conducted in the laboratory.

The content of this coursebook is split into two parts, 15 lecture units for the Fall and Spring semesters in each part. Some of the units may, however, need more than 2 lecture hours while other, less than 2 hours. Each chapter comprises the body of a lecture together with illustration material and a short glossary of technical terms at the end of each chapter.

Many problems in the coursebook are open ended, i.e. students are given 5 to 10 minutes to solve a problem. As an example, after due explanation on preload in bolted connections, students are asked to evaluate the influence of the parts and bolt stiffness on the maximum and residual load in a connection (Fig. 1).

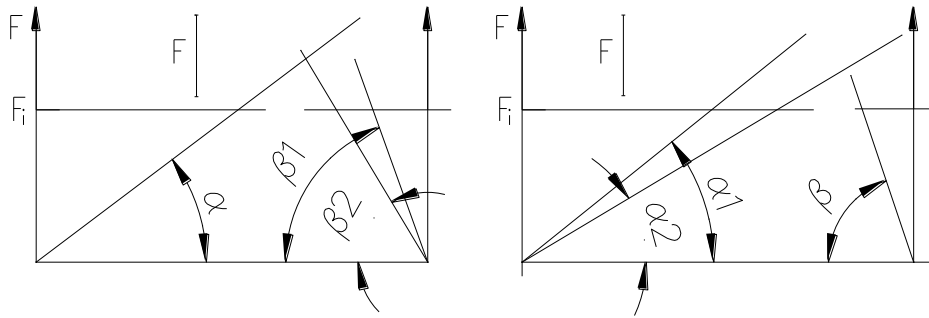


Fig. 1. Influence of the parts and bolt stiffness on the maximum and residual load in a bolted connection with preload (Fig. 5.5 in [5])

Rys. 1. Wpływ sztywności kołnierza i śruby na obciążenie maksymalne i resztkowe w połączeniu śrubowym z zaciskiem wstępnym (rys. 5.5 w [5])

Some of the drawings, denoted by a dark triangle (stub drawings), shall be completed concurrently with the teacher's explanations during the lecture.

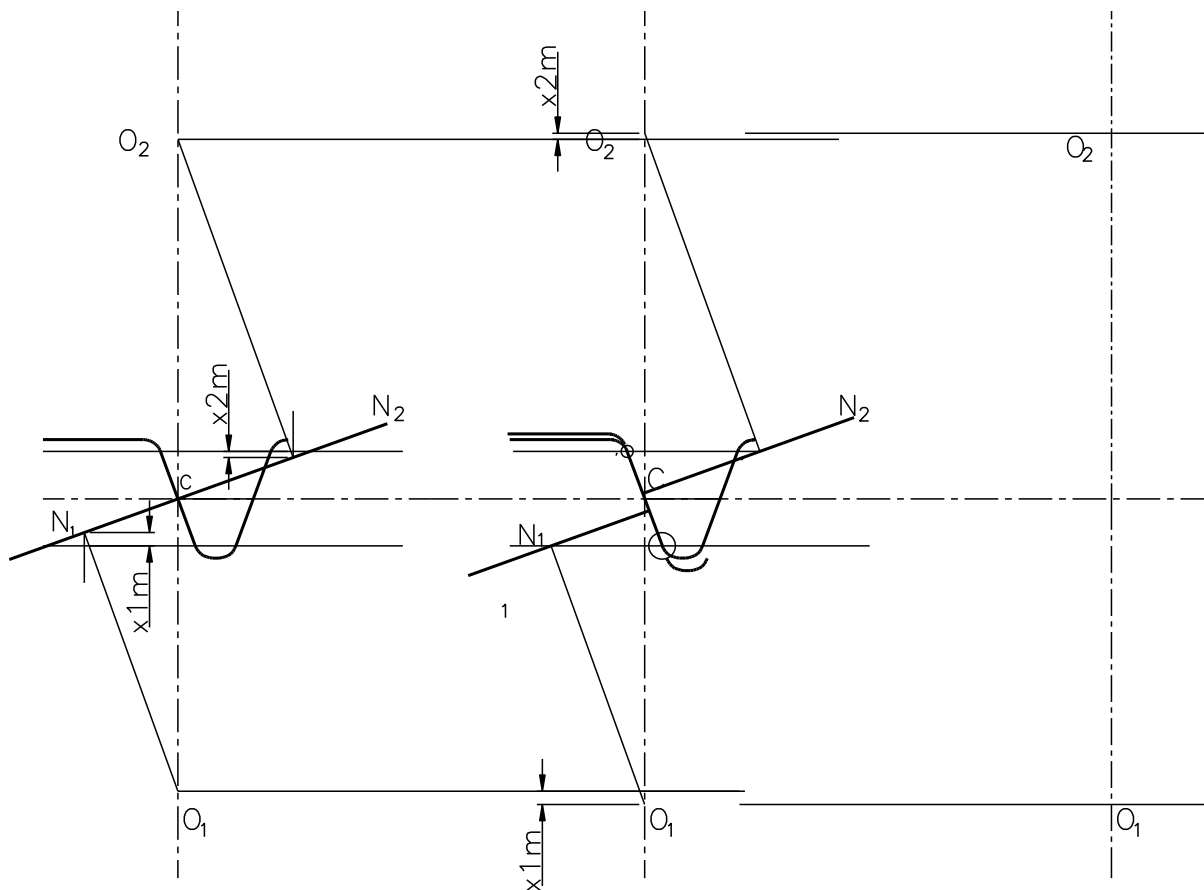


Fig. 2. Angular correction (21.1 in [5] ▲)

Rys. 2. Korekcja kątowna (21.1 w [5])

These are mostly difficult drawing for which prepared is a skeleton leaving essentials to be done during the lecture. Specifically, in the above drawing: the left drawing presents the starting situation for the explanation of the angular correction. In the middle drawing, the two involute profiles showing excessive backlash are constructed by the teacher. Finally,

explained will be the need for a certain contraction in the centre distance to eliminate this backlash. The final drawing is sketched by the teacher from the scratch.

To enhance practical skills of the student, most of the lectures are provided with relevant numerical problems (NP). Each lecture is followed by at least one or two numerical problems to be solved by students at home (HW). It is a standard practice in many technical universities to accompany any lecture with a set of homework assignments, which account usually for 10 marks out of 100 as the students' coursework. Model solutions to these problems are made available to all students as a means for the control of their self-study effort done at home.

Notation and symbols: As the majority of student attending this course are those Polish students who are willing to learn and practice their skills in technical English, symbols, subscripts and superscripts in this course book relate mostly to Polish textbooks. The author decided therefore to carry out all strength analyses in terms of design stresses (e.g. k_r) and not with respect to the elasticity limit (R_e), a practice employed in all American textbooks (a good practice as it makes the student responsible for the proper choice of the factor of safety).

Those students who do not feel sufficiently confident with English may use a word-per-word translation of this coursebook offered to those students who register this course with Polish as the language of instruction. The coursebook is provided with appendices and tables useful for the solution of all problems included in the book.

3.2. Cons and Pros of the coursebook

Cons: Some students have a habit to mechanically put down teacher's instructions without giving much attention to a problem discussed. With the coursebook they seem somehow confused. Most of the students, however, use the free place available for additional remarks and comments. Some of the students are not able to align the topic discussed with the relevant part in the coursebook. The illustration material shall be improved on a few instances.

Pros: The coursebook provides the entirety of the teacher's instruction, the whole verbal message, which is usually omitted in lecture notes. The understanding of the taught material, especially after a lapse of time, is therefore easier, makes students fully attentive and aware of what is going during the whole lecture. The final examination is usually an open coursebook one and the coursebook is the only teaching aid acceptable; thus valued by the students.

This coursebook might be a good starting point to write a textbook covering all topics discussed during this course at different Universities. This task, if deemed purposeful, would need a collective effort of many teachers.

4. LABORATORY AND DESIGN CLASSES

The problem of teaching aids is here even more acute. Laboratory experiments are Faculty specific: there are no other teaching aids available save of those prepared for Polish students and translated into English. Students shall be informed on valid safety hazards and strict experiment oriented procedures (if the experiment is not limited to observation only).

It may be contrary to a common belief but teaching design classes is, in the author's opinion, more English language demanding than giving a lecture. A discussion on a specific design solution may end in this region of English proficiency where even an experienced

teacher may feel at a loss. Discussion with a student barely literate in English on design issues might be a nightmare too.

When preparing simple design tasks, students need very frequently valid standards. It is very difficult for foreign students to navigate through Polish standards and handbooks on machine design. In preparation is a comprehensive guide for the first and second semester design classes based, especially for the second semester, on the most popular textbook by prof. Kurmaz [6].

Computer teaching aids are offered in Polish or need an active input based on prompts given also in Polish. Needed is the reverse localisation of those programmes into English (internationalisation), which is time consuming and on many occasions, inutile as the available software (Kiss) is better and more user friendly. It must, however, be purchased. Yet another problem, that of licensed AutoCAD versions in English, was finally solved at our Faculty: 15 programs were installed at one of the computer rooms just two years ago.

5. FINAL REMARKS

1. The number of foreign students will increase in the near future, irrespective of the current policy of the EC with regard to the Erasmus programme and the fact that after first-year lenient treatment of foreign students, teachers (including the author) become more tough and demanding. Failed courses become a standard if a student does not fulfil the course requirements in their entirety.
2. Better results are recorded for those students who take the full first degree programme in Poland. Students visiting the University within the framework of the Erasmus programme are often focused on topics that are totally in disagreement with the University curriculum.
3. There is an urgent need to improve the existing coursebook [5] (illustration material, alignment of symbols) and to prepare teaching aids in design tutorial courses. Navigation through Polish standards and handbooks is extremely difficult for foreign students. Available calculation assisting computer programmes need reverse localisation.
4. There is a need for a comprehensive one semester course in the Fundamentals, designed like an orientation course in machine design and targeted to those students whose background in terms of prerequisites is very poor (many students, especially from Germany, are of Industrial, not Mechanical background). One more reason is that the Erasmus students register usually for part one of the Fundamentals course only.

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