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Architectural education to improve technical detailing in professional practice

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ABSTRACT: Common practice among architects is to be active on building sites, while performing supervision of construction works. On many occasions, the architect is expected to produce proposals on the spot as to some modification or detail. To do this, professionals in the field must exhibit relevant skills concerning comprehensible and legible sketches of building details. But, at the start of their professional careers, graduates may encounter substantial problems, thus being incapable of satisfying such expectations. The reason seemingly is the education system, which usually fails to teach students how to make detailed sketches. This requires a special and careful approach aimed at substantial modification of students' vision of their future occupation. In this article, the author investigates the problem and indicates multiple reasons for this situation. Through a set of instructions or rubrics, potential improvements to the teaching system are proposed.

Keywords: Sketching criteria, teaching system, students' vision of architecture

INTRODUCTION

The preparation of graduates from universities for entrance to a given profession has been debated frequently in academic, industrial and institutional circles. Different approaches depend on the character of the professional discipline. This holds also in the engineering professions, including architecture. The issue is regularly raised during consultations between the local chambers of architects and the academics of schools of architecture. Professionals represented by the local chambers of architects regularly opine as to the incomplete education of students whom they employ after graduation, and see their deficiencies related to insufficient skills revealed during office work. As Duffy claims: *Older architects sometimes lament what they see as a decline in technical skill among their younger colleagues* [1].

Many schools of architecture report failure by their graduates to meet employers' expectations. Among many enumerated missing skills discussed in this article will be the notoriously exhibited incapacity to communicate effectively with professionals on building sites, while performing supervising activities on behalf of the architecture office or their own projects. It is not only about the poor knowledge of procedures used on building sites, but also misunderstanding professional communication with construction management and building teams.

Even if the lack of professional terminology is not a substantial problem, there is a need for effective transfer of spatial and technical information from the design office that frequently proves to be a real obstacle in mutual relations and can hamper development. Communication between professionals on building sites takes a dual form: verbal and visual. *In design practice visual communication is central to collaboration at all stages, each with its own conventions, depending on the types of collaborators and the demands of the situation* [2].

If the verbal communication relies mainly on the effective spoken expression of spatial concepts and relevant technical knowledge related to designed buildings and their components, the visual interpretation of the communicated information depends on graphic skills acquired by students during their course. This is not only about the students of architecture, but also other majors related to architecture, such as interior design. Some use the term, *visuals*, for architectonic graphic sketches [3].

The main purpose of this article is to convey analysis of the visual communication methods taught in architecture schools, based on the curriculum of the Faculty of Architecture at Cracow University of Technology (FA-CUT),

Kraków, Poland. Given the critical remarks above, a new approach to the issue designed to improve the effects of forming graphics has been elaborated. In this article, the author presents the findings of a research study carried out in recent years.

METHODOLOGY

The research presented in this article has led to an educational concept designed to improve teaching outcomes of students' communication skills, and hence the skills of the graduates with engineering and construction specialties. It is necessary to undertake a thorough analysis of the present educational system relating to this issue. But, as is shown in the research, the roots of that system and its drawbacks are deep, leading to an untrue vision of the profession common among students at the early stages of their education. Such an image of architectural studies to be held by the population also should be considered.

The freshman phase of the study seems not to have changed much these deep-rooted convictions. Thus, the endeavours of teaching staff in the area of technical communication for prospective architects at an early stage encounter serious impediments. The research is divided into three parts: the first is where the reasons for the present unsatisfactory situation are tackled; phase two is to overview the students' skills in graphics (second year of study); and the third phase is where a method is suggested aimed at substantial improvement in teaching methods. The aim is to devise a rational system of assessment for technical sketching.

The side-effect of this proposed system is to turn attention of the freshmen at an early stage of education to the significance of technical graphic presentation of building solutions, and to encourage them to develop more interest in this aspect of their future profession. As many professionals claim: *It is imperative that the concepts involved in engineered solutions are taught to architectural students and conveyed to practitioners* [4].

DOMINANT VISIONS OF THE PROFESSION OF ARCHITECT

The opinions circulating about the character of some professions turn out in reality to be false. Architects are seen virtually as artists and their professional qualities are assessed, usually on the basis of their aesthetical achievements represented by buildings they have designed. Only rarely are the buildings' functional aspects considered by their users, and even less frequently by others. The technical performance of buildings is of lesser interest, and the role of a building is debated only when some defects of the building components or materials come to light; that usually comes about after a certain time has passed, exhibiting low durability of building systems.

The evaluation of architecture exerts a significant impact on the popular vision of architects as *artists*, playing down other equivalent aspects of the profession. These common convictions are also shared by potential candidates of architecture schools.

An important negative contribution to the obviously false vision of the profession is the way in which the published guides for potential students inform them about the character of both the architectural profession and architectural studies. The advice presents predominantly *limited* aspects of their future occupation. However, having enrolled in the first year of architecture study seems not to much change the students' view of the profession.

The lack of modification of such views results from the attitude of some academic teachers who sustain the students' naïve convictions, focusing chiefly on the aesthetic aspects and values of designs and completely neglecting the remaining problems of buildings. This predestines graduates for future painful confrontations with the realities in architecture offices, as well as on building sites.

EDUCATIONAL METHODS

> *Learning architecture is a rather complicated matter, because it is a combination of theoretical and practical knowledge. Schools of architecture with their limited flexibility must constantly react to the transformation of the architectural profession* [5].

This opinion adds to the necessity for deep modification of the teaching methods. This is apart from the artistic vision of the profession, and focuses mainly on the technical problems of architecture and architectural education. The importance of the technical approach to shaping space is confirmed with the so-called Vitruvius triad, which is *firmitas-utilitas-venustas* (strength-utility-beauty) [6]: the first *(firmitas)* relating to structure and technology.

The technical aspects of buildings are covered in a few subjects within the programme curricula in all architectural schools, for example construction, building technologies, structures, and other. It is the subject of building construction (or general building construction in the case of the FA-CUT), which is mainly responsible for the architect's communication with other specialised stakeholders in the building process. The weight of this practical element of the educational system is of primary importance; therefore, this subject and the organisation of it, as well as the content, should be analysed.

Legény, Špaček and Morgenstein state:

> *When talking about architecture (initially the building process), all the construction skills at the beginning have not been taught primarily through words or theories, but mainly through the practical acquisition of sequences of operations. They were improved and refined by means of passing them from generation to generation* [5].

This statement points directly to practical aspects of the exercise of the profession and, in consequence, to teaching methods, which should include significant practical content. As a result, the practical internship on a building site is a compulsory element of curricula in all architecture schools. Inspecting and learning technical solutions in buildings under construction permits not only seeing positive examples but also faulty ones, which is highly instructive. *Teaching students to avoid mistakes is just as important as teaching them how to design, draw plans or cultivate their creativity* [5].

Technical subjects are bound to designs, because building technologies are presently causing most of the problems in architecture:

> *Technology is dramatically altering workflows, from conception and representation to analysis, evaluation, production, and fabrication. Moreover, technology is changing the nature of design practice by restructuring the relationships between designers, fabricators, consultants, clients and stakeholders at the same time that increasing project demands are spawning practices with specialized technical capabilities* [2].

This pervasive impact of technologies on design and construction should be a decisive factor in modifying architectural education systems. Therefore, students' visits on building sites, being an important element of technical education, may significantly improve teaching outcomes by the formation of feedback loops [7]. This would enhance the body of knowledge, passed on to students, related to building technologies, the role of which is constantly increasing. *Feedback is the act of giving and receiving constructive criticism and is a key communication tool in a collaborative design process. An important feedback principle is that negative feedback has a more profound impact than positive feedback …as negative stimuli produce stronger reactions and have more powerful influence* than positive stimuli. This is the *negativity bias* [2].

INTERDISCIPLINARY COMMUNICATION IN BUILDING INVESTMENT

The professional activity of architects is performed in two basic ways: producing architectural designs and taking care of proper execution of buildings in accordance with their plans. Both stages require contacts and collaboration with other specialists. In the latter case, it will be mainly with construction engineers and building workers. Practitioners need to apply their knowledge situationally:

> *The design professional (architect) has two important responsibilities during bidding …one of them is processing substitution requests …for materials and systems. Substitutions may be requested during the bidding phase, during the construction phase or during both phases* [8].

Typical building investment procedures are shown in Figure 1.

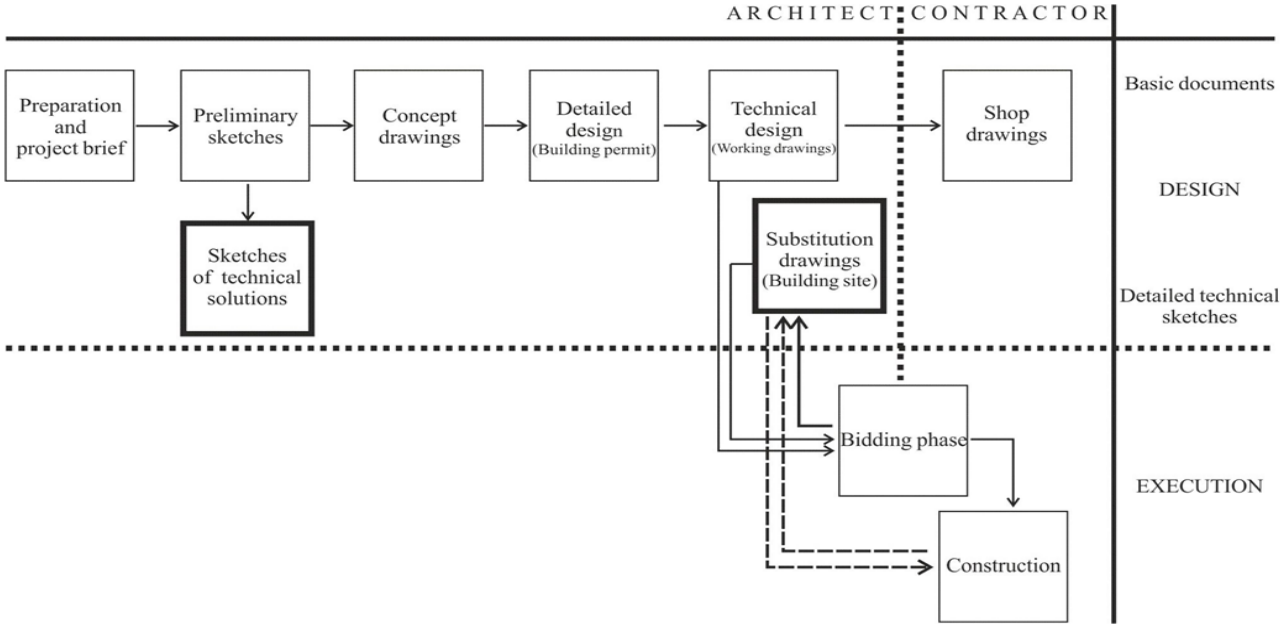


Figure 1: Typical building design process and the position of technical sketches (Source: Author's diagram).

Graphic communication forms a critical tool for describing how to meet emerging performance standards [9]. The basic tools of communication in the construction process are drawings and specifications. In the process of

construction, it often is revealed that building components, details and materials must be modified or exchanged. This is the operation in which architects become involved and must then approve the new solution.

On many occasions, it is the architect's role to deliver such solutions in the form of freehand sketches made *in situ*, because there is not time for regular technical drawings made in the office. Moreover, face-to-face contact between specialists makes a big difference, because …*Conflicts arise from processes, methods and academic training. Differences between the ways architects and engineers are educated - with one focusing on open-ended problem finding and the other emphasizing single-solution problem solving* [10], are the reason thereof.

Professional communication by way of sketches made by architects turns out to be highly useful and efficient in such critical situations. For practical reasons it is hardly imaginable to use such documents computer-drawn on a building site, but also because there is a *fundamental collision between the ways we connect digitally, and the connections our brain was designed to crave …This is because* [of] *the lack of nuance in digital communication* [11].

Moreover, Pallasmaa, a Finnish architect, advocates *for the immediate connection between the architect's mind and his or her drawing hand - the thinking hand* [5]. This traditional method of graphic communication proves to be the most rational method on contemporary construction sites. These images are an aid for those involved to facilitate discussion about the design and allow the construction team to propose changes to the construction. The design team often accepts changes to their initial design. The same holds true for documents such as shop drawings prepared by contractors or fabricators of building elements. *Shop drawings are drawings prepared by the contractor to illustrate the plan for achieving the designer's intent and constructing the work. Contractors' shop drawings provide an opportunity for dialogue and increase the collaborative nature of decision making* [2].

Sometimes mock-ups are the key communication tool between design and construction teams; then, shop drawings are unnecessary. But if shop drawings are used, frequently it is also the architects employed by construction firms who are involved in their preparation. The architect, client and contractor form a triangular relationship and the role of the architect is also to carry out *ad hoc* explanatory sketches. *Sharing the sketches back and forth became an essential part of the dialogue of the project* [2].

Important decisions usually are taken in design offices. But organisation of the office works is changing. The idea of so-called *lateral leadership* [12] as a method of working in design offices that describes … *the situations in which no single person has sole decision-making authority* [12] can only encourage the taking of decisions onsite by architects. This requires sporadically the production of rapid technical sketches. *In Japan, a tradition of collaboration and flexibility in the relationship between designers and constructors* [has] *been that designers produce a flexible and incomplete set of contract documents, and designers and contractors work together on site during the construction process to arrive at construction details* [13].

Multidisciplinary collaborative work that Japanese architects are used to requires many discussions during which a rapid and comprehensive method of graphic presentation is most useful. In the wake of innovations in organisation …*contemporary leadership has shifted toward a more networked concept, in which it is a collective social process consisting of the sharing …of responsibilities among various individuals, team organizations, and other entities* [14]. The decision-making directly on building sites by architects using rapid, explanatory technical sketches within such specialised teams is essential.

THE FREEHAND SKETCH FOR PROFESSIONAL COMMUNICATION AND AS A METHOD OF ASSESSMENT

> *The larger trend now is that owners are beginning to want evidence that architects are able to produce buildings that are performing well...* and …*this is bringing clients deeper into conversation …transforming the relationship between designers and owners* [2].

It seems reasonable to turn students' attention to their capacity to produce comprehensive technical sketches, not only for construction specialists but also for investors. This is based on many years of teaching experience of the subject, Building Construction. Technical sketches as assignments, verifying exercises or semester examinations by over 200 students every academic year within this subject were the basic material for analysis.

The abundancy of comparative materials has revealed some repetitive characteristics of sketches. Students' interest in the assessment of every sketch means disillusionment and doubts must be treated in a supportive though objective way. Devising a reliable and convincing evaluation tool of their works is necessary. That was the genesis of this research.

An analysis of the present situation regarding assessment of students' technical sketches resulted in a draft *rubric* (see Table 1). It contains four criteria with each assigned suitable grade points. These are:

A. Technical correctness.
B. Completeness of presentation: quantity of information, degree of detail.
C. Clarity of information: suitability of scale and proportions of presented details of components, accuracy of detailing.

D. Quality of the graphic: technique of drawing (e.g. freehand drawing, use of ruler, mixed), quality of lines (rectilinear or curves), type of drawing tool (e.g. pencil, felt-tip pen, pen).

Table 1: Formative assessment scoring rubric for students' technical sketches. A sample for sketch is in Figure 2a (Source: Author's diagram.)

Grade points	Technical correctness	Completeness of presentation	Clarity of information	Graphic quality	Total score
	Criterion A	B	C	D	A + B + C + D
1					
2					
3			●	●	15
4		●			
5	●				20 max.

The proposed rubrics provide:

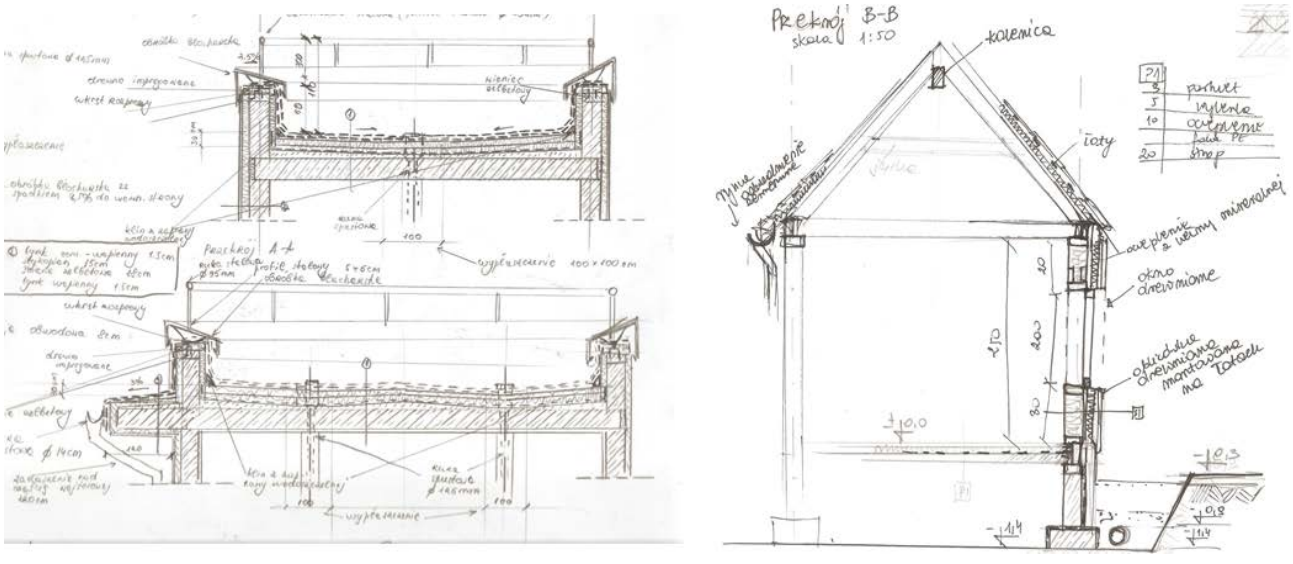
- Comparison of sketching skills between students.
- Indication of strengths and weaknesses of sketches.
- Assessment of students' technical knowledge.
- Identification of the weakest elements of visual communication.

The evaluation procedure will indicate for each assessed student which criterion needs have been met and which aspects of sketching need to be improved. Findings suggest that rubrics, when used with formative assessments, have a positive impact on students' learning [15].

DISCUSSION

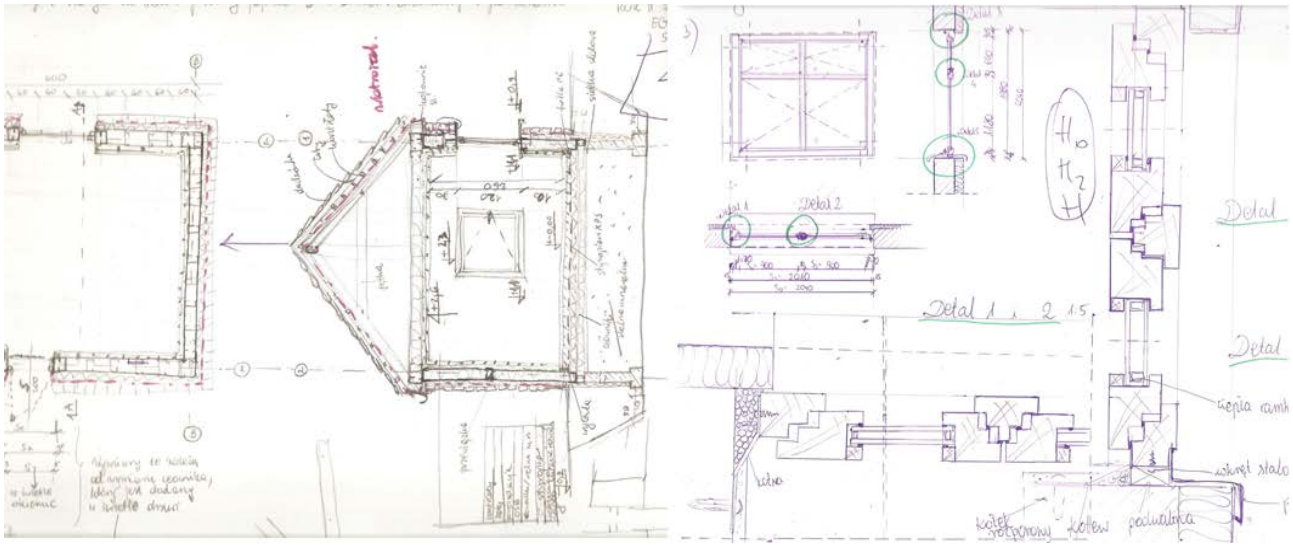
The method presented, based on the application of rubrics, is a natural option for improvement and optimisation of the students' evaluation procedure. Methods of assessment of drawings are always subjective, at least in some aspects. *New models will always be partial and incomplete, but it is worthwhile to create them* [5]. So, there was no expectation of finding a way to create an entirely objective evaluation system for technical sketches, just as it is in the case of freehand drawings, which are even more difficult to frame into an objective validation system.

However, technical drawings can be assessed by applying a more objective method. Of the main four proposed criteria (see above) criterion B: *Completeness of presentation: quantity of information, degree of detail* and D: *Quality of the graphic: technique of drawing*, being more subjective than the remaining two, can be considered ambiguous and even questionable. In this case, a comparative method applied for two similar sketches can be considered a decisive tool. Whether it is possible to reliably compare and assess students' technical drawings can be discussed on the basis of exemplary analyses of sets of graphic presentations under the same criterion. The following pairs of sketches are a good illustration of visible differences between them, permitting the ascribing of relevant grade points to each one (Figure 2, Figure 3 and Figure 4).



a) b)

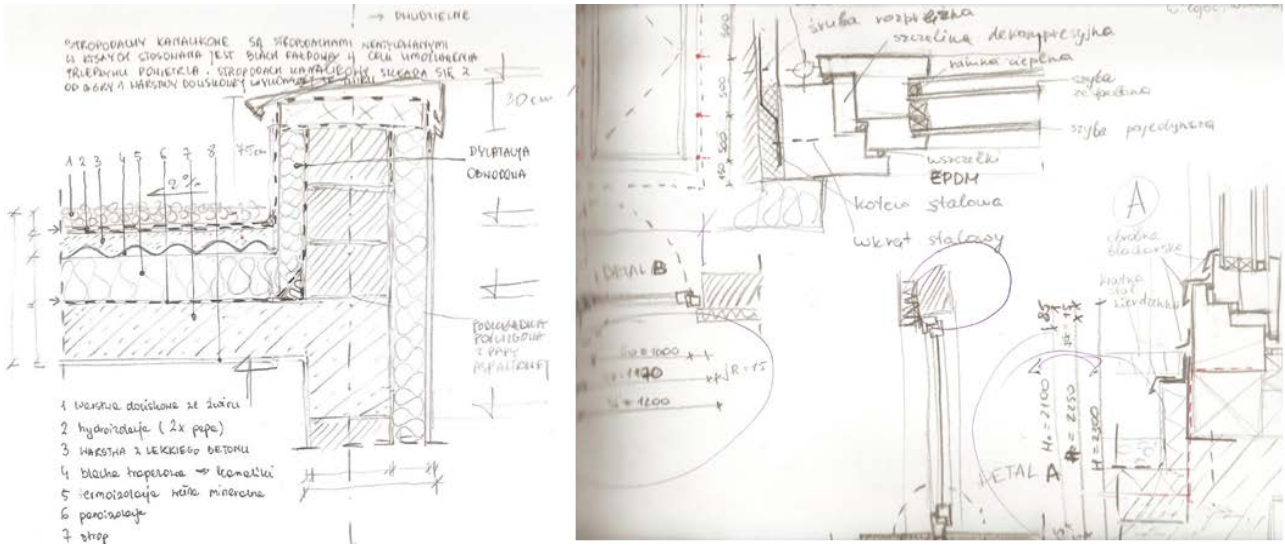
Figure 2: Comparison of two technical sketches in terms of their completeness (criterion B); a) complete; and b) incomplete. Examination sketches, second year of study.



a) b)

Figure 3: Comparison of two technical sketches in terms of their accuracy of detailing (criterion C); a) accurate; and b) inaccurate. Examination sketches, second year of study.

Despite the obvious subjectivity of the evaluation of drawings, some degree of objectivity of professional assessment can be achieved because of precise specification of a few criteria. This can validate the proposed method for application, which allows resolution of the educational problem.



a) b)

Figure 4: Comparison of two technical sketches in terms of their graphics technique (criterion D); a) freehand-drawing; and b) drawing to ruler. Examination sketches, second year of study.

CONCLUSIONS

Findings suggest the optimised assessment tool devised, a rubric with criteria A to D, was suitable for the task studied. The tool should contribute to a better understanding of strengths and weaknesses of technical sketches by the students, and thus, to an acceptance of the relevant assessment. It would also allow for them to make suitable improvements to their drawings due to a more precise identification of the committed imperfections or errors.

The awareness of criteria applied to the evaluation would also permit attention to be paid to a suitable treatment of every single element and trait of the sketch, in view of its compliance with the clearly stated requirements related to the well-known and specified criteria. This concept is designed to increase the awareness of students concerning the significance of professional communication between architects, architects and other stakeholders, and especially architects and contractors.

The more the educational methods emphasise the issue of the competency of graduates on building sites, as far as professional communication is concerned, the more likely it is that the students will modify their attitude towards the technology-related building documentation and will be better prepared for their profession.

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BIOGRAPHY

Wacław Celadyn is a Professor of Architecture at Cracow University of Technology in Kraków, Poland. He is also Director of the Institute of Construction Design, Chair of Construction and Building Systems, and a former Deputy Rector of the University. At present, he teaches construction, building technologies and architectural design. Between 1985 and 1987, he also taught in Algeria and later in California, USA. His scientific research covers ecological design, low-energy buildings, new technologies in architecture and problems of technical durability of buildings. He was a practising architect in Poland and Canada, between 1987 and 1992, where he worked with several architecture offices and established his own design office. The buildings Prof. Celadyn designed were residential, institutional, sports and commercial facilities. He was a member of the Royal Architectural Institute of Canada and had the Ordre des Architectes du Québec. From 2003 to 2010, he was President of the Municipal Committee for Architecture and Urban Planning in Kraków.