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Latest trends in design engineering education

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Abstract:

Since mass and product movement are increasingly dependent on trains, tracks must be stronger and last longer. Rail steel's mechanical characteristics, especially strength and hardness, must be increased. Pearlitic rail steel grade 900A offers good tensile and impact qualities. Steel tested had good dividend and tensile strengths but limited elongation. Using an RVE model, the impact of the bainitic phase on pearlitic rail steels was examined. The phases' ultimate shear curves were defined by chemical composition. Thus, the relationship between predicted elastic modulus and tensile strengths as a function of bainite phase fraction was determined. This model determines rail steel's microstructure.

Keywords:

Accelerated Cooling, Bainite, Cooling Curves, Microstructure, Mechanical Properties, Pearlitic Steel, RVE Model, Rail Steel

1. Introduction:

Design engineering has seen a change from more scientific forms of design theory to more learner-centered approaches that take into consideration human and social elements in the design activity. (Love, 2021). An educational tendency that emphasizes socializing (in this case, in a design lab), rather than individual study, may be seen in this development. Assuming there is an absorption process, this recognizes a 'shared enterprise' when it comes to producing new definitions (Atherton, 2017). Applied expertise in creative thinking and idea generation is a key component of product design engineering. Assigned task is increasingly being used in the classroom to assist students to integrate, apply, and expand on the knowledge they've learned in their theoretical lectures. Project-based learning is a term used in educational literature to describe this type of learning in which students work together to solve issues, develop solutions, and present their findings (Edutopia, 2016). Project-based learning provides many advantages over traditional teaching techniques, including greater knowledge of the subject matter, enhanced self-direction as motivation, and enhanced investigation and problem-solving skills.

1.1. Aim of research

By using what students have learned in Design and Technology, Mathematics, and Science in the classroom, the projects hope to improve the students' understanding of engineering as well as their interest in and enthusiasm for the field.

1.2. Research objective

Accessibility, aesthetics, economic effectiveness, operational efficiency, historic preservation, productivity/safety, and sustainability are all essential design considerations.

1.3. Research question

1) First and foremost, what is a designer's job?
2) What is the role of mechanical engineering design in the industry?
3) What are the responsibilities of a designer?
4) Why is mechanical engineering design so important?
5) Are design engineers going to be a thing of the past?

2. Literature Review:

2.1 Design process:

The term "design" has been defined in a variety of ways (Dym, 1994). In the definition of engineering design is given as follows: "design phase is a thorough, smart operation in which design team yield, evaluate, but instead specify constructs for equipment, systems, or operations whose practicality achieve clients' objectives or users' needs while comforting a defined set of constraints."

This phase includes the identification of a need, a problem to be solved, and the gathering of information. This phase includes the generation of concepts and the making of decisions.

A number of variables contribute to the difficulty of learning, teaching, and assessing design knowledge in the executive phase, including: One of the most important things to remember about the design process is that it is iterative and non-linear, thus the three stages listed above don't have to be carried out in the order listed.

Secondly, Design Thinking is regarded as a method of questioning that is both divergent and convergent. True solutions (facts) can be found through the use of converging thinking, which is frequent in the knowledge base. Divergent thinking, on the other hand, provides several possible responses regardless of whether or not they are true or incorrect for a given subject. It is challenging to teach and assess design thinking because it is a sequence of conversions from the conception area to the knowledge base (Ishii, 2016).

Recognition – system dynamics and are able to foresee unintended outcomes that may arise from interactions between components. They also have the ability to deal with ambiguity and defend their judgments in unclear situations, which are typical in the design field. Many university students lack the capacity to think critically and creatively.

Engineering design education relies heavily on design language; yet evaluating design language is a difficult task in and of itself (Atman, Kilgore and McKenna, 2008).

The design process is considered as a collaborative effort. This ability to work in multi-disciplinary teams is a characteristic of good designers. As a result, in most engineering institutions, lecturers tend to focus primarily on imparting technical information. Consequently, there is a lack of preparation for pupils to work in groups effectively. A lack of assistance or training can lead to unpleasant experiences and attitudes about future teamwork, making the learning curriculum less successful.

According to (Aboalela and Khan, 2018), the conceivable remedy (final product) might not have been universally accepted because it is just one of many alternatives in the design challenge. Also, the final result may not accurately reflect the abilities of each member of the team to work together and communicate effectively. When it comes to assessment, it's important to look at the full process, rather than just the finished product.

2.2. Design engineering:

It is the responsibility of design engineering to ensure the safety of the specific product as well as the safety of its users, to limit environmental hazards, to comply with all applicable laws and regulations and to deliver the product in an acceptable state of performance. Because of this, design engineering should include numerous distinct phases and steps, but not usually in the prescribed order. Rather, it should be done iteratively and recursively. Figure 1 shows the basic sequence of problem solutions.

Clarifying the issue, for example by establishing a design specification, and then searching for possible solutions evaluating the potential options to identify the most suitable one, making a decision, and transferring the solution offer to a higher level of detail or to an executing entity. The actions are backed (Eder, Hubka and Benabdallah, 2011). In the process of obtaining and preparing data, Reflection, checking, and verifying Drawings and/or computer-based digital models can be used to represent, for example. A (hierarchically superior) methodology's problem-solving steps always follow this pattern. Detailed instructions can be provided for each of these processes (prescriptions).

2.3. Design thinking as divergent-convergent:

During the problem definition stage of any concept design or class, asking questions becomes an important first step (Ishii, 2016). No sooner have the goals for the designed artifact been established by the customer or the professor than the designers—whether in an actual design studio or in a classroom—want to know just what the client truly desires. What makes a product safe? What do they mean by "cheap" when you talk about this product? In your opinion, what is the best? Design is, without a doubt, incomplete without some form of questioning. Today's curricula for engineers are heavily based on epistemological approaches, where established and proved concepts are used to evaluate an issue and arrive at verifiable, "truthful" answers or solutions. Is systematic questioning appropriate in a design setting, as it appears to be? Considering that design educators already believe that tools and approaches used to aid designers' creativity are "means of asking questions, then providing and seeing the answers as the design process evolves" (Ishii, 2016). An affirmative explanation seems likely.

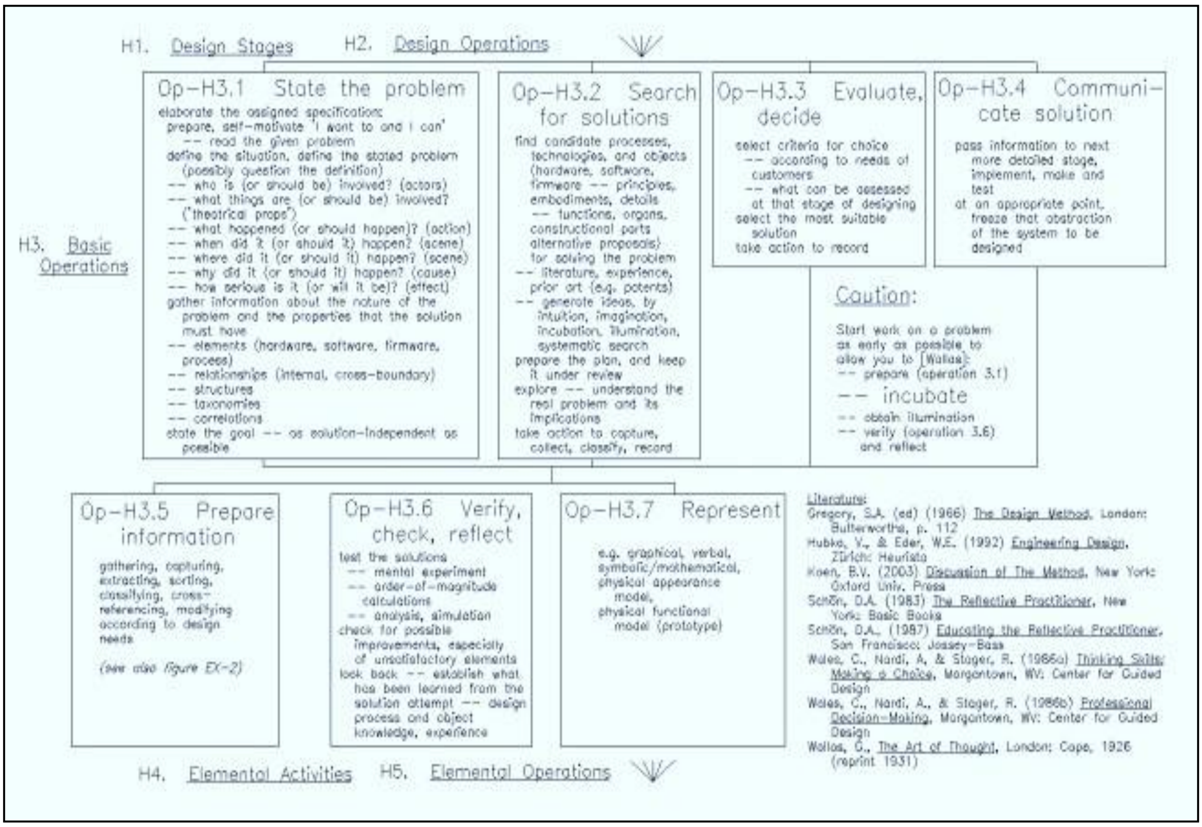

Figure.1: Problem solving (source: Eder, Hubka and Benabdallah, 2011)

2.4. Making design decisions:

These ruling design frameworks have a common basic principle: that development is a reasonable process of selecting among a variety of design options. Some have questioned the soundness of design decisions in terms of science and math. It is Hazelrigg's contention that in order for engineering design to be really rational, it must be based on the realization that design phase is a ruling process and the adaptation of theories from other domains, such as economists and decision theory (Hazelrigg, 1999).

2.5. Design thinking in a team environment:

One of the many socio-technological components of design is being more recognized and taught (Dym, Wesner and Winner, 2003). ABET's general engineering requirements take the psychological context of education degree into account on multiple levels, which is helpful.

3. Methodology:

3.1. Data summary:

Primary data is gathered through the process of data collecting. In order to perform this research, researchers conducted structured interviews with a variety of student groups (first, second, and fourth year).

3.2. Data analysis:

Engineering design can be evaluated by examining students' ability to think critically and creatively. Students' approaches to open-ended challenges have also been explored through the medium of interviews. According to the Perry model, student cognitive processes progress from simple black-and-white thought to a more complicated appraisal of various options in some research studies. Firstly, two, and fourth-year year students were interviewed for an hour and a half to determine the Perry model's level. The leading and follow-up questions in a structured interview are designed to guide the interviewee through the process (to encourage students to provide more details about their thinking and justify their points of view). The recorded data and Perry's level were analyzed using verbal evaluation methods. The Perry paradigm was also used to investigate the impact of that first design class on engineering students' intellectual growth.

4. Findings and discussions:

For generations, the importance of safety issues throughout design phases for production materials and systems is understood. With the growth of nanotechnologies, various writers identified the design of processes as an effective strategy to prevent hazards Therefore; terms like safe-by-design are also used to refer to ways leading to increase the security of 2005 contends or to cleaner processes. The design analysis technique proposed helps to examine and comprehend the workplace conditions in the process of designing.

5. Conclusion:

This paper summarizes various engineering design reevaluations. As a result, most engineers choose quantitative methods since they are familiar with numbers. It is possible to get a more complete picture of the engineering set by using qualitative evaluation techniques or indeed a mix using both various methods and techniques.

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