

## A TOOL ADDRESSED TO EVALUATION AND ASSEMBLY OF SOLIDS MECHANICS WEB PAGES

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***Abstract:** The objective of the present work is to present a tool to evaluation and assembly of solids mechanics web pages which are produced for engineering courses. First, the paper shows the use of web pages as educational and research tools and the intensity of resources such web pages might provide. After, the focus will be to point out a general view of solids mechanics web pages already in activity and the needs demands by this discipline from the information technologies. Finally, the paper will show a propose for a tool which aided the solids mechanics web pages evaluation and assembly. This tool is aimed at evaluating questions on use of the information technologies, showed issues, teaching methodology and relevance degree of the web page in virtual world, as well as providing important points for web pages building process.*

***Key-words:** Web page, Solids Mechanics, Distance learning, Evaluation*

### 1. INTRODUCTION

The knowledge accumulation and the use of this for own ends and the application in the society appeared as a successive search of the individual, starting of the moment where the man developed the critical thought. Through the times, the social and technological revolutions modified the man's *modus vivendi*, and they had taken to an stage of great use of his intellectual capacity, concentrating the acquired knowledge and using it to place the own man in the hegemony of the evolutionary stage.

The search for the well elaborated information it is one of the basic principles for the formation of a critical cognitive process. The imperative of launching a seminal and differentiated methodology opposes to the reality that the individual crosses in the society of the knowledge.

ROUSSEAU (1999) affirms that the human intelligence possesses limits. Still according to the author, what must be chosen it should be taught, what is really useful to be passed ahead in knowledge form.

But how should that knowledge is transmitted? How much is useful this knowledge for the formation of the pupil? Or better: being taken into account that in every thought line possesses your balances and limits, borders exist for such knowledge?

When the knowledge is not just used to define a border between the teacher and the student, when it is used to create bridges among subjects not only academic, but daily also, when the knowledge instigates the student to expand your sensorial limits, a bi-directional

factor is created between the teacher and the student, doing with that the barriers that impeded the growth of this don't just how a product of the knowledge tax, but as a knowledge creator, break up and give place to the renewed and critical thought.

The will of settling down a teaching-learning entail cannot leave of a formal imposition of the educator. The induction to the expansion of the cognitive process should only happen if there the curiosity and or the student's will. The master should habituate the student to have perception and to impress with the sensitive truths, and for that it should place problems that he leaves it anxious and restless and make it to think. ROUSSEAU (1999) leaves that well defined when affirming that the education should promote the spontaneous development of the sensibility.

It should also be taken into account the contextualization of the contents, that is a resource that contributes so that the students act on your learning, once it provokes them, it instigates them to elaborate hypotheses, to look for information, to confront different ideas, different explanations, to notice the limits of each explanation, besides of those that they already possessed, in the perspective of the construction of their knowledge. In that sense, the knowledge cannot be disentailed of elements of the personal, social and cultural life. The academic contents win meaning when bridges are built among what is learned in the daily and the academy (DALAL *et al.*, 2000).

One of the most important factors associated to the productivity in the education is the desire to learn of the student. Without any doubt, this longing is increased with the presentation of lives her material attractive, which motivates the student, propitiating an active and cooperative learning atmosphere, supplying the certain autonomy degree in your educational process also counting with the other students collaboration (LEE and SULLIVAN, 1996).

## **2. EDUCATION AND RESEARCHES THROUGH WEB PAGES**

Nowadays, we live in the middle of the information age. Our ethos is more and more “cyberacultured”, making the growing information society state themselves as it, demanding their people for assimilate all this technological evolution in a constant and hectic movement, changing their identity inside their typical community; considering the identity from the adopted concept by CASTELLS (1999), who says that this is the process through who a social actor recognizes himself and build meaning based mainly in an specific cultural attribute or in a attributes whole.

SILVA (2003) says that internet helped the dissemination of the new and improved distance teaching method, point that it was an despised alternative since it started to be used in brazilian educational system, due to lack of interaction between the material studied - who looked like a cake recipe - and the interested person, who wants not only learn, but understand the kind of information given.

The internet gives interactivity to the apprentice, that is, dialogue, creation and control of learning process up against management and authorship tools; without being an strict, restrict and centralizer tool, because it is not based in transmission of elaborated information by a production center. With it, the connected computer is like an opened system to the agents, allowing them to participate and to interfere in the information exchange and in the knowledge building.

It's clear to see the contribution of the information technologies in the construction of teaching helping tools. The adoption of computers and softwares can be pleasant and in fact motivates the students for a mutual learning process. The tradition manners of learning presented in classrooms can be completed with the use of the interactive helping systems based in computers (LIMA *et al.*, 2000).

The multimedia allows an approach to the natural cognitive work. As the information in a good multimedia product can be crossed, confronted and added in any instant of time, the multimedia becomes a source of information that is almost tuned in to the normal cognitive activity (DALAL *et al.*, 2000).

Web pages can list the informations through texts, sounds and images, as well to point other pages with thematic similar, where can be obtained more datas. However, the potential offered by this tool it is not totally used. Relative difficulties are verified to the problem of the

poverty of information verified in a lot of pages and the lack of constant updatings of the datas, as well as the design of pages that hinder the navigation on the part of the user, and the low use and little integration of the media resources (LIMA *et al.*, 2000).

Due to these needs, not more should model them web educational pages without giving the due attention to the referring subjects to the gender of writing and making. Firstly, the educational web page should integrate relative aspects into the web commercial pages and the personal home pages.

SINGH and DALAL (1999) highlight the web page as advertisements, tends the basic functions of inform and persuade; being able to not this way to show and to disclose the technical capacities developed by the responsible group by the web page, to obtain partnerships with other group academics, other publics had gone of to university and or private entities and attract new students to develop research works. SINGH and DALAL (1999) also affirm that the emotional aspect is of fundamental importance to attract the user, being this aspect including subjects as the structure of the web page and the intensive and integrated use of technologies of information, the content and teaching methodology and possess references of another web similar pages, as well as to have relevance (in)formational, being a recognized instrument of learning. This emotional aspect is increased when we used a narrative, a speech form that attracts the reader, allowing the non lineal reading of the web page contents, as well as taking care of the language and of the methodology of exhibition of the subject (ROBERTS, 1999).

It does not have to neglect these previous considerations alleging that a web educational page has an only speech and “scientific”. The construction of a web page should observe the target public, looking for an organicity among this public's several component actors, possessors of needs and different objects, even so always understanding liabilities. This way, looking for inspiration in the anthropology, to function-author highlighted by SINDER (2002) and GEERTZ (2002) should pilgrim in the roads of the scientific writing and of the literary writing, uniting the technical rigidity without losing the charm of a narrative that swallows the reader for the interior of the approached subjects, breaking the paradigm of the absorption of the information for another one based on the dialectics of the construction of the knowledge. With this, the knowledge stops having a property magnetic and dogmatic, in which the author is used of artifices to convince the reader on the authenticity and validity of the information, and starts to have a changeability characteristic, where not more he has space for an information with demarcations not questioning liabilities.

### **3. SOLIDS MECHANICS WEB PAGES**

The web pages produced by the departments and for the members of the engineering faculty's have three general functions basically: information for the students body and external community, disposal of didactic material and popularization of researches led by the members or for research intern's groups.

We will keep our focus on the disposal of didactic material, live specifically the relative the solids mechanics.

The use of the multimedia resources in the teaching of this content becomes very important, because several subjects of solids mechanics demand certain abstraction degree, which can be worth of these resources. Instead of a textual explanation with some illustration, the student can receive an informative complement through different medias.

When we used the term “solids mechanics” for the group of knowledge that involves the relative studies to the behavior of mechanical systems and structural, we are approaching of the subjects approached in the course of mechanical engineering. Even so, other terms adopted for the same group possess closer equivalence to the civil engineering as “strength of materials”, “structural mechanics” or “mechanics of the materials.”

However, for the present work, this differentiation won't exist, therefore intends to work with the subjects common to these denominations. These subjects are described in the Table 1 and later on more detailed.

Table 1 – Basic Contents of Solid Mechanics.

Shear force and bending moment diagrams
Stress and strain
Mechanical properties of solids
Axial load
Shear
Bending
Torsion
Combined loadings
Stress and strain transformation
Deflection of beams
Failure criteria
Energy methods
Buckling of columns

This organization of subjects privileges the differentiation for loading which a certain system can suffer. This way, there is the possibility to insert specificities for structural component as the beams (presents in all the didactic books of mechanics of the solids), as well as other more complexes as the plates, shells and membranes. Also, later on, the numerical solutions can be implemented for each one of the topics starting from some discretization method.

For web pages in solids mechanics, there is not the need of the use of sounds. With this, the media needs will be concentrated in the adoption of images, videos, chats and discussion forums.

The use of images and videos (in the format of simple animations) are fundamentals for the understanding of the application of the loading in the system, as well as the evolution of the linear strains and rotational. Understanding these varied, the modeling of the system is processed in an easier way, because the problem of this subject is in the fact that the ways educational printed papers don't allow this visualization type, being very difficult the interpretation of the application of loading as the one of pure bending.

The chats use and discussion forums are fundamental so that the users have possibility to change ideas, to share and to solve doubts among them and with the responsible persons for the web page. These two tools facilitate the cognitive process, because they approach users and responsible for the propagation of that knowledge, allowing manages new knowledge perfectly shared for the internet.

Other important characteristic for learning in solid mechanics is change values in examples. This is make through field on the user put the desired values or for variable displacements for mouse drag.

GONÇALVES and CANEGIN (2002) and SCHEER *et al.* (2000) detach the use for Java, in format of the Java Applets, because this is an open platform and expansible for the educational systems. The Java Applets allow the visualization in abacuses or graphics trace's and are automatically installed and executed as web page part.

Certainly, many doubts would be solved in solids mechanics with the help of the information technologies, because the visualization of the phenomena's occurred in the material's deformation and the possibility of successive repetitions, as well the act of consult several subjects at the same time, helps the student to construct his knowledge, conglomerating the mathematical shaping and its boundaries and initials conditions

#### **4. ISSUES FOR EVALUATION SOLIDS MECHANICS WEB PAGES**

To present evaluation proposal its seal attention for three aspects that influence in the success of a web page, being these complement and exhaustive for the wanted analysis. These factors are: structures and resources of the web page, contents and teaching methodologies and degree of relevance of the web page.

##### **4.1 Structures and resources of the web page**

The programmatic part and the content should always be the main focus for portals of the style that we are proposing. But, from the popularization of the Internet, the world wide web acquired a format gone back to the interactivity, where they are taken so much into account the visual as the dynamism in the hyperlinks organization and valid information.

The contents will be the principal focus for evaluation proposed. With popularization of internet, the interactive process is fundamental.

In relation to the visual, there is a lot comes been noticed the referring abuses the use of colors, sources, images and multimedia resources. That invariably leaves the page with the aspect "weight", leaving the difficult and delayed navigation (mainly with the delay for the download of images, programs and big animations - in the subject size of the file - in relation to connection used by the user), unassuming with the appearance, if we take in consideration that the tendency for a site with academic themes is a visual clean and optimized, not allowing graphic extravagances and nor a series of windows appearing in the screen.

The background with colors that contrast with the text (and that are pleasant to the vision), light images and optimized, and animations that don't disturb the navigation they are basic precepts to attract a public and to maintain it. The organization of the links and of the approached subjects they can be presented in a map, that would inform the user where he is located and where can locate such intended information.

SILVA *et al.* (2003) presents in a systematic way the necessary elements for the constitution of a web page gone back to the implementation of an interactive process of teaching-learning.

Another subject is already previously the need of communication mechanisms shown in this work. Without this, as attests SILVA (2003), the web page practically resembles each other to an electronic book or a video screen, reproducing the old teaching forms and learning.

## 4.2 Contents and teaching methodologies

### *Approached subjects*

With this approach, we want to evaluate the inclusion of the web analyzed page. With this, we can be verified the web page it intends to reach the total subject of the area of solid mechanics or to specialize in some specific topics.

### *Use of the models*

One of the most complex passages in the resolution of engineering problems is to express it mathematically. Besides this problem to be derived of the difficulties in the handling of the mathematical tools, there is also the subject (not always simple) of the visualization of the physical model, when this is introduced most of the time in the schematic format.

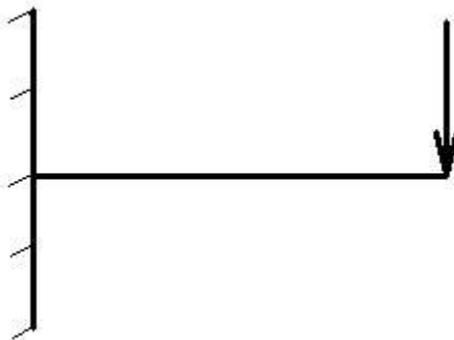


Figure 1– Schematic model of a fixed beam in one of extremities.

LEE and SULLIVAN (1996) attest the importance of being possible the visualization of the three models: physical, schematic and mathematical.

The physical model corresponds to the found in the real world, being able to be a structure of the nature or built by the man. The use of this model type approaches the student of the approached subject and it turns the most active, investigative and useful study, as highlights LINDBERG NETO *et al.* (2001).

The schematic model is the most usual in the didactic publications and it seeks to simplify the real structures with its support conditions and shipments. This way, it cannot him in little lines to represent a complex problem.

The mathematical model seeks to represent the physical model in equations (algebraic or differentials) and restriction parameters (initial and boundary conditions). This model only gets to be very defined if the models physicist and schematic they are well described.

The integrated use in the three ways of modeling of a problem facilitates the learning, because the student finds correspondence with the real world that surrounds it and that demands of him certain knowledge degree for the exercise of the engineering.

### ***Examples, exercises and insert of data***

So that the learning process is complete, it only is not enough to accompany the development and solution of the mathematical model. PALMA (2003) alerts for the fact that the students' great part tends to solve exercises without knowing the theory. A culture is had of reading only the resolutions of the exercises.

With this, the web page should possess examples, showing from the presentation of the physical problem to the mathematical solution. However, losing temper some entrance data, the answer varies, what is explained by the theoretical foundations, visible in the models physicist and schematic. With this, fields for insert of relative data to the material and geometry of the physical component; it forms, magnitude and positioning of the shipment and support conditions are interesting to show the variations of answer in a numeric way, exemplifying in everybody the senses the solution of the problem.

Finally, as form of to motivate the student and to offer more an alternative for the consultation online or presential, is interesting that the web page has exercises proposed with answer sheet. Besides, this option offers opportunities for the person to practice the resolution of problems, defining the models physic, schematic and mathematical, allying theory and practice and facilitating the construction of the knowledge.

### ***Linear and nor linear reading***

In relation to the printed didactic resources, them web pages possesses the advantage of they allow a non linear reading of the contents. That is, can have access to any subject and to pass for another one through a click.

As form of to ally the possibility of this non linear reading with the care and not to open up several windows (what would turn the consultation to them web pages practically impossible, due to the excessive number of open pages and that not always the user access the internet for a high-speed connection), we believed that the best hierarchical structure for a web educational page is the proposal for MENGEL and ADAMS (1996) and visualized in the Figure 2.



Figure 2 – Hierarchical structures for a web page (MENGEL and ADAMS, 1996).

This structure foresees that each subject listed in the Table 1 is opened in a specific page. Each thematic of a subject is consulted in the own page of the subject, what impedes the proliferation of several open windows.

For a better understanding about the possibilities of reading of a web page, the same should have in its initial page the listing (and corresponding links) of the approached subjects and the map of possible localizations.

### **4.3 Relevance degree of the web page**

With the growth of the importance of the diffusion of the knowledge through the cybernetic space, some attempts of settling down an evaluation with quantitative boarding were elaborated and proposed. With the qualitative evaluations, the quantitative techniques can supply important subsidies.

This proposal received the denomination of “webometrics” (ALMIND and INGWERSEN, 1997), being also called of “cybermetrics” (SMITH, 1997) or of “internetometrics” (VANTI, 2002); being the first more usual.

Amongst the evaluation variables adopted by the webometrics, which are found in the works of ALMIND and INGWERSEN (1997) and INGWERSEN (1998), we will use four of these for the present study.

#### ***Number of pages in web page***

This factor can indicate a larger organization of the topics of the web page, what facilitates a non linear reading of the content of the same, besides aiming a larger inclusion of the treated subjects. With this variable, it can be verified which them web pages that include a larger number of the relative subjects to the mechanics of the solids.

#### ***Number of external links in web page***

This factor can indicate the as certain web page is integrated with other relative ones into the same subject. As larger this integration, easier it is the search of data for the modernization of the web page and the aiming for web pages that possess contents non agreements in the moment and or that still use not some technology of information applicable.

#### ***Number of links with points a web page***

This factor can indicate the prominence of a web page in relation to the other ones, showing which web pages is references for another. This listing type has as cause the recognition of the importance of a web page for the one that indicated it, as well as it can show the research nets and changes of established information for the responsible of the web referring pages to a specific subject. This way, not more we explained this phenomenon for the generalist analysis supplied by VANTI (2002), which concludes that the generating mechanism is practically linked to the persuasion capacity in the community of the responsible persons for the web pages.

#### ***Web impact factor***

This factor is proposed by INGWERSEN (1998) and also discussed by SMITH (1999) and THELWALL (2000); and has as objective to unite the relative evaluations to the importance of the web page with to returned them for the relevance and inclusion of the information. This factor is supplied by the reason: number of links that indicate the web page for number of referenced web pages

INGWERSEN (1998) alerts for the fact that this factor will have values variables in the time, because web pages is dynamic objects, being able to not be altered or suppressed. With this, the factor’s type doesn't find likeness with used him for the scientific citations.

### **4.4 An observation: search engines inconsistencies**

One of the great problems for the use of the present evaluation methods is the lack of search efficient engines, because the internet possesses a dynamic nature of real time and an immense not standardized mass of data.

OPPENHEIM et al. (2000) promote a review of the search engines in internet it divides them in four categories: robot-driven search engines, directory-based search engines, goal-

search engines and software tools. The first are the most common and the more studied concerning the inconsistencies of the results. The directory-based search engines is set in listings of web pages divided by subject in an automatic way and the goal-search engines uses databases maintained by companies operators of the media world. The software tools is bases of data similar to the goal-search engines, even so requesting payment and needing workstations and facilities of softwares, being allowed the digital storage of the results of the researches.

HOU and ZHANG (2003) alert for the fact that the use of algorithms of search of web pages not always it takes result it satisfactory. The search for web important pages should take in consideration contexts that not always they are visible in the titles, subtitles and presentation summaries. Another factor to be considered is the dynamic and transitory aspect of the internet, which not always it is detected by these search engines.

In what says respect, more specifically, to the used search engines, HOU and ZHANG (2003) attest a series of logical inconsistencies that hinder the mensuration of the data contained in the bases. These search engines lose information, because web pages mentioned in a first moment is not more found by them in a following research. According to NOTESS (2000), these inconsistencies are going besides the accountancy inability. The processing can take it resulted spurious for the fact that the resources used to elaborate the search strategies (truncation, researches for fields and boolean operators) not always they operate in a perfect way, reducing its capacity when these are combined. They are also mentioned the difficulty that these search engines possesses to identify certain characteristics of a web page, as the context or the general subject which the document fits.

Then, makes himself necessary to implement solutions of search engines of public domain without the free limitations of the current ones. For a specific subject, universities, laboratories and groups and research institutions are setting up electronic guides, listing all them web relative pages to the theme, as it can be verified in the work of BRANQUINHO and COLODETE (2002) for the mineral-metallurgical section. These electronic guides can also include relationships of web pages divided by more specific sections of the subject main and or by use certain technologies of information, implementing a sailing based on genres, according to the proposal presented by ROUSSINOV *et al.* (2001).

## 5. CONCLUSIONS

This work looked for to list the main elements for the evaluation and assembly of web pages in solids mechanics, involving qualitative and quantitative variables and with attention to the user's cognitive process, which requests the use of technologies of information as form of supplying the needs originating from of the abstraction degree for the visualization and understanding of the associated physical phenomenon.

Starting from the considerations of this work, a proposal of future initiative is the constitution of a portal that is an electronic guide of web pages in solids mechanics. The constitution of these specific portals comes if constituting in facilitators in the research of precise contents in the internet, as it can be verified in the work of SCHEER *et al.* (2004) for the case of educational objects (as animations and Java Applets) in mechanics of structures.

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