5th INTERNATIONAL MEETING OF THE CARPATHIAN REGION SPECIALISTS IN THE FIELD OF GEARS

USAGE OF COMPUTER AIDED TECHNOLOGIES IN A RAIL VEHICLES DESIGN

Juraj Gerlici, Ferdinand Janíček, Tomáš Lack, University of Žilina, Slovak Republic.

Abstract: *The paper deals with the possibility of usage CAx system CATIA V5 in the product design and development which is used under the conditions of Department of Rail vehicles, Engines and Lifting Equipment, Faculty of Mechanical Engineering, University of Žilina in the field of research and for student education. This program system is suitable not only for 3D virtual model building, but also for technical documentation generation, structural analysis execution, product data management, product lifecycle management and it has many more capabilities.*

Key words: *computer aided technologies, CATIA, railway vehicles design.*

1. INTRODUCTION

New products development is regulated mainly by customer requirements and the customers requirements are resulting from producer possibilities and other economical conditions. Limiting factors that influence a product development are: ability smart market analysis and priorities and methodologies determining on achievement destination, in term of competitive position analysis, integration of people, tools, methodologies and resources within enterprise, cost minimisation on development, prototyping and application products to series production, cost minimisation on manufacturing, production optimisation methods, production, optimisation flows and series production cooperating regards, product innovation and changes comprehensive management at generating plant.

2. APPLICATION AREA

There are the most advanced industrial branch just those branch of world economy, which is possible to define by these facilities (automotive, aerospace, electronics, electrical and consumer goods industries) and which are generated definitive moving strength at development new technologies and products at the same time, as well as into IT and CAx technology putting to development process of new products including their applications.

Designing process, new products development and innovation members stay directly on the way between customers and production.

Design engineer after graduation should get ready to meet up-to date demands given by developed industrial society. His or her knowledge should be very good in special professional direction and of course some knowledge and experience with technical software system tools for rapid product development and evaluation are for them very useful. There are more software tools that can be exploited.

The main tool used in our computer aided… laboratory is an integrated suite of Computer Aided Design (CAD), Computer Aided Engineering (CAE), and Computer Aided Manufacturing (CAM) applications for digital product definition and simulation, CATIA V5. This software tool provides advanced 3D Product Lifecycle Management (PLM) solutions for collaborative product development.

No happen, that CATIA system is occupying analogical status in hierarchy integrated business control. Exploitation computer support technology has on Department of Rail Vehicles Engines and Lifting Equipment long-time tradition at designing. Technical documentation is creating by means of appropriate software systems performing of engineering calculations at the students' processing constructional design at project managing, processing registered work, knowing reviews and institutional research problem solution.

2. CAX SYSTEM IMPLEMENTATION INTO EDUCATION PROCESS

Determining step was assurance nine PC data processing workstations for implementation system CATIA V5 to process educations on Department of Railway Vehicles, Engines and Lifting Equipment [4]. The students graduated basic course, are adapting fundamentals model parts design in 2D and 3D as well as overall system philosophy. Rail vehicle design project was native continuation exploitation studies entity of system.

Dismemberment the students' to groups over singular specialization of Transport and manipulation technique (Railway Vehicles, Machine and Equipment design, Railroad repairing machines was created themselves setting partial task on common teamwork's

project. At project destination was the design Y25 cargo bogie virtual model and static analysis on some parts.

We are using CAx system CATIA V5 for education and projects solution. CATIA (Computer Aided Three-Dimensional Interactive Application solutions) is integrated software application used for designing, mechanical engineer computations and computer supplement in the mechanical engineering. The system CATIA is comprehensive CAx system. It is compound from different parts. All the system covers a large part of industry demands. For our usage is important section of design and structure analysis. For us, the basic and very important part is Mechanical design [1, 2]. It is compound from parts too.

Mechanical design provides the necessary tools to perform advanced 3D design of parts by Part design and assemblies by Assembly Design in the context of the full scale digital mock-up and generation of production drawings by Generative Drafting.

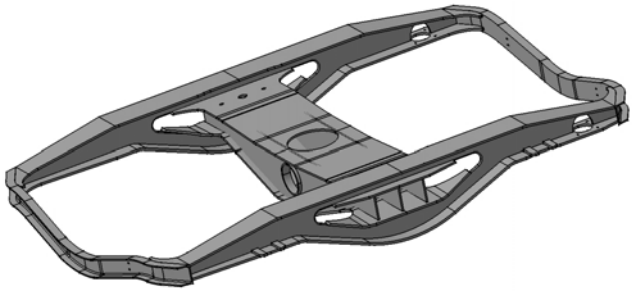

Fig. 1 *Virtual computational model of bogie Y25 frame for structural analysis made in Part Design.*

Part Design is a product, which provides a hybrid modeller for part design (Fig.1). Involving the most commonly used associative features with the flexibility of Boolean approach it offers a highly productive and intuitive solution enabling multiple design methodologies. One can sketch and design in assembly context with user-control of associativity, add design constraints in the local 3D parameterization, manage easily modifications with the support of multi-body parts for example, operate flexible post-design operations.

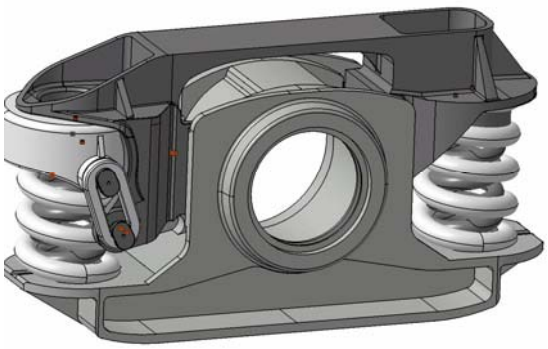

Fig. 2 *Assembly Design.*

Assembly Design establishes mechanical assembly constraints using mouse movements or graphical commands to easily and intuitively snap parts into position (Fig.2).

Generative Shape Design & Styling (GSD) helps to design mechanical shapes based on a combination of wire frame and multiple surface features (Fig.3). It thus provides an extensive set of tools for creating and modifying mechanical surfaces used in the design of complex shapes or hybrid parts.

Analyse is module with tools for structural stress and vibration analysis on parts of Generative Part Structural Analysis, structural stress and vibration analysis on assemblies Generative Assembly Structural Analysis and predict the tolerance specified on assembly considering the whole sheet-metal assembly process Tolerance Analysis of Deformable Assembly.

Generative Part Structural Analysis (GPS) addresses transparent and automatic structural stress and vibration analysis on parts, integrating the simulation and design specifications for change propagation and integrates advanced pre-processing, solving and post-processing capabilities.

Generative Assembly Structural Analysis (GAS) performs stress and vibration analysis for

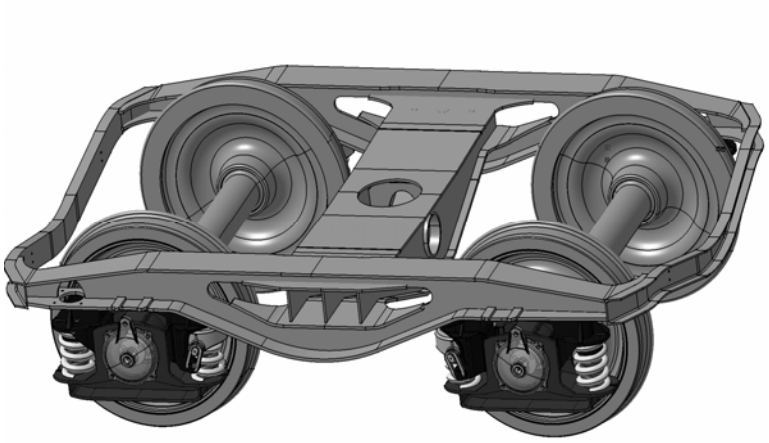

Fig. 3 *Virtual model of Y25 railway bogie.*

assemblies of any type as surface, solid, wireframe and hybrid.

Tolerance Analysis of Deformable Assembly (TAA) is a product, which performs tolerance analysis on sheet-metal assembly. This analysis takes into account the product, process and resources involved in the assembly. It can be used in the design phase to help the designers to specify, and/or validate the assembly process (like assembly order or welding / riveting order), the tolerance specified, the geometry and the property of the sheet-metal part (like thickness, material). It can be also used in the manufacturing phase (from measured

variations) to find some corrective actions, thanks to sensitivity analysis, and to set-up the process (like adding some new locators, modifying welding order).

3. BOGIE Y25 PARTS ANALYSIS

The virtual model of railway bogie Y25 as an example is here mentioned. The singular module is integrated into system directly, 3D model is basically simple for using Finite Element Method analysis (FEM) [3, 5], straightforward and relatively exactness from part designs aspect and boundary conditions definition. Parts of the bogie Y25, they were graded look like tetrahedron alternatively hexahedron dimensional finite element, with reference to resultant geometry [6]. Computation is high-speed relatively after loading condition existing stress, what is however dependent from model involvement, stress amount and variety, restraints, mass facilities look like and others boundary conditions. Problems can come into being by methods calculations selection, results comparison and following indicate computation reliability in coincidence from regular standards. There were on some parts of Y25 executed the static analysis conformable with integrated FEM solver

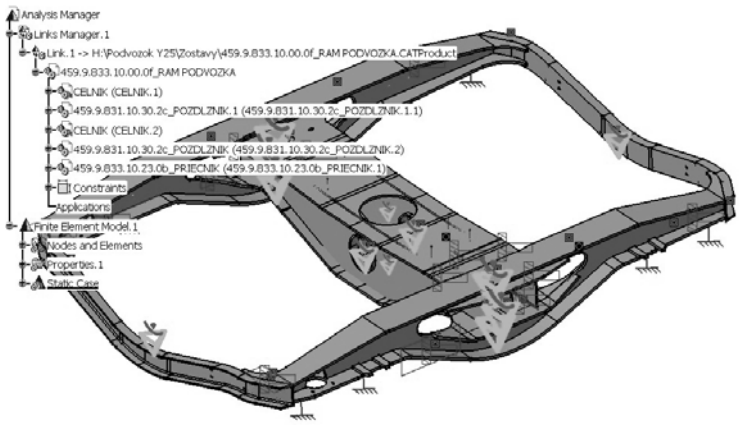

Fig. 4 *Structural analysis of a model – boundary conditions*

The solver investigates maximum stress tension, maximum pressure, maximum stress sliding and maximum stress reduction conformable with Von-Misses plasticity condition. Magnitudes acquired by model analysis should be not allowed larger as magnitudes acquired by computation according to this method. Data evaluation was carried out analogical according to the Slovak technical norm. But we are going by compare from computation hardness derivation from boundary yield stress, alternatively boundary tensile strength.

Finite Element Method analysis provides by a long chalk in more detail tenseness analysis then includes standards downloadable conventional computation [7]. It is required on analysis come into question theoretical assumes, which bring into inaccuracy to computation (loading

condition linearity, unlimited mass model elasticity, etc.). Be needed eliminate their influence on designing application. It is wearing by genesis tightness load peak just in locality with indent or abrupt transitions. Stress singleness is resulting in this site, in which is local growing till up everything boundary near theoretical infinite elastic mass. Therefore convenience selection greatness and modality several meshing element just interacted substantiality analyses and reality parts stress. We are used on problem solution tools FEM Surface and FEM Solid.

4. CONCLUSION

Rail vehicle is from the point of view of construction design the technical and technologic demanding product. It must demand requests of standard parameters determined in UIC leaflets and various states and railways standards. The design and railway vehicle parameters have to tune these strictly given valid standards. In consequence of a wide variety of section and subsection of railway vehicles and their nodes the implementation of CATIA system is economic, technologic and personal demanding, but very strategic useful process.

The decisive factor of the cooperation of the various design and manufacturing companies is the proportion of system implementation. It is necessary for flexible cooperation of various companies (or chain of production) to have and to use one (the same or compatible with) software development system. When these demands are fulfilled, no problem in technical communication when appears virtual model development. Project management, reciprocal data and information transmission and railway vehicles virtual prototype development process will be full supported by corresponding tools of the system and will be included in the frame of product data management and product life management module.

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