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STUDY ON THE CONNECTING ROD STRAINS USING FINITE ELEMENT ANALISYS

M. RISTEA[1] A. PRUIU[1] A. DRAGALINA[1] T. FLOREA[1] A. POPA[1] T.V. FLOREA[2]

Abstract: *The total forces occured on the engine`s moving parts are determined by adding the value of the pressure forces to the innertia forces, acting according to the cylinder main axis. In the case of the variable compression ratio, there are major chalenges, concerning the strenght of the internal combustion engine`s parts*

Key words: *ratio, compression, strains, stresses*

1. Introduction

The term „finite element" was introduced in year 1960 by Clough and was proven in time as a very powerful mean for solving different technical problems.

Generally a structural analysis has four stages:
- defining the analysis objectm type and dimensions;
- modelling the structure and boudary conditions;
- defining the loads;
- carrying the analysis and evaluating the results

The analysis type and dimension are depending on the nature of the expected structural answer. Generally, we have the following structural responses tipology:
- stresses and displacements for a load case;
- specific vybrations
- structural elements stability response

The loads are in following categories:
- extreme forces and pressures;
- forces obtained by the structural weight;
- thermal loads obtained during the internal combustion cycle`s developement.

Generally, we may consider linear analysis, sufficient. The non-linear responses are to be considered in following situations;
- for elastic structures, with major displacements;
- in stability analisys for structural elements
- when are observed plastic displacements.

2. The Initial Conditions for Generating and Studying the Models and The Connecting Rod`s Stresses in Considered Situations

First, we will consider as an initial data set, the values obtained from the ALCO 12 R 251 FMA engine.

[1] Dept. of Naval Installations and Machinery, "Mircea cel Batran" Naval Academy of Constanta
[2] S.C. "Delatreid" - Constanta

The main data for ALCO 12 R 251 FMA engine Table 1

Bore	228,6	mm
Turatia nominala	1000	rot/min
Athmospheric pressure	1,632	bar
The pressure at the end of the compression process	52,5519	bar
The maximum burning pressure	122,955	bar
The pressure at the end of the expansion process	5,7087	bar
The exhausting pressure	1,36	bar
The connecting rod`s weight	32,6	kg
The connecting rod`s weight correspondingly to the piston	9,78	kg
The connecting rod`s weight correspondingly to the crankshaft	22,82	kg

The material specifications Table 2

The element	**Alloy type**	**Yield strenght**	**Breaking strenght**
The crankshaft	30MoC10	745	865
Connecting rod	40MoCN15	915	1020
Piston`s head	30MoVC12	905	990
Wrist pin	18MnCr13	840	925

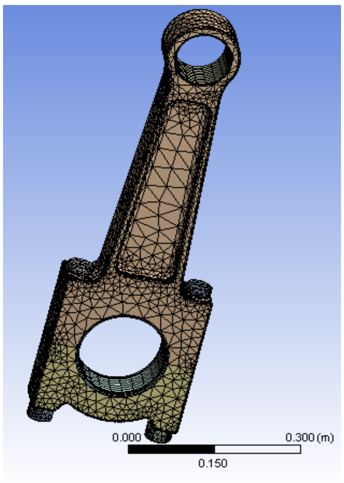


Fig. 1. *The connecting rod for ALCO 12 R 251 FMA engine with ε=12,5*

The functional parameters used in the following analysis was obtained during some tests carried in the Naval Academy from Constanta. We will consider two situations.

In the first case, we will analise the situation of the real engine, when the compression ration value is 12,5 (figure 1), the real situation and in the second case we will consider the situation when the compression ratio value is 14,208.

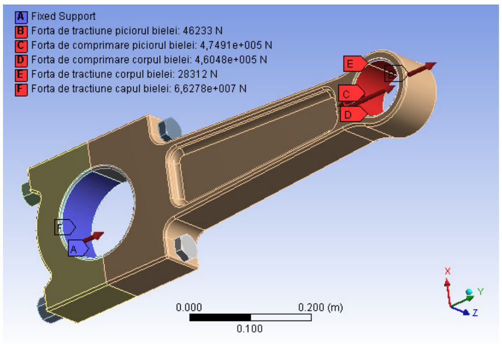
At the end, we will compare the results obtained in both situations, considering the stresses resulted with specified variations.

3. The Forces and Loads System for the Study Model

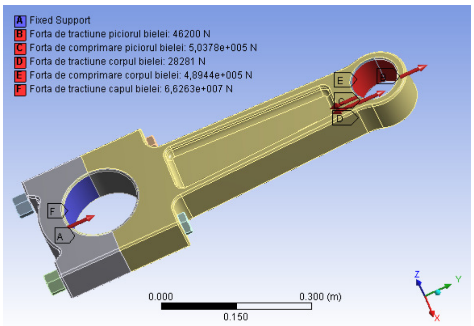
The required elements in order to generate the load system was obtained from the developement of cynematic, dynamic and resistance calculus, for each case (more precisely the case with a value of the compression ratio of 12,5 and respectively of 14,208). The results are presented in Table 3:

The load system for both considered cases Table 3

The stress	**ε=12,5**	**ε=14,208**
The traction stress on the connectig rod`s base [N]	46233	46200
The compression stress on the connecting rod`s base [N]	$4{,}7491*10^5$	$5{,}0378*10^5$
The compression stress on the connecting rod`s body [N]	$4{,}6048*10^5$	$4{,}8944*10^5$
The traction stress on the connecting rod`s body [N]	28312	28281
The traction stress on the connecting rod`s head [N]	$6{,}6278*10^7$	$6{,}6263*10^7$



a)

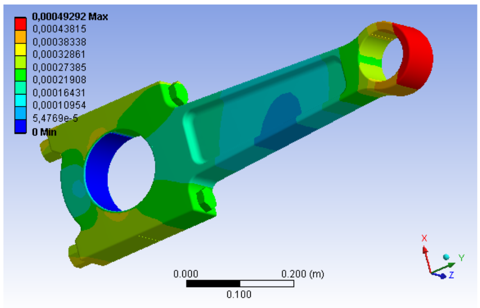


b)

Fig. 2. *The load system*
a) for the real engine;
b) for the obtained model

4. The Results Obtained during the Analisys

After finalising the load system as in figures 4.a and 4.b, the analisys was started, and the main results occured were total displacements and equivalent stresses.



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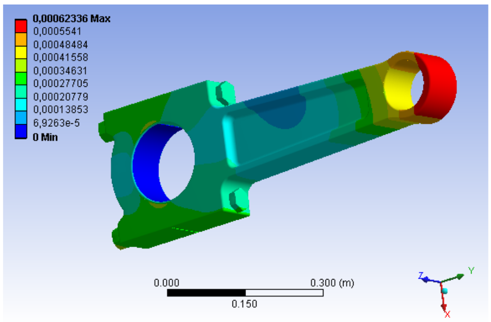
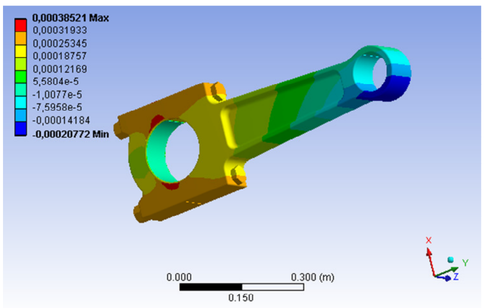


b)

Fig. 3. *Total displacements*
a) for the real engine;
b) for the obtained model



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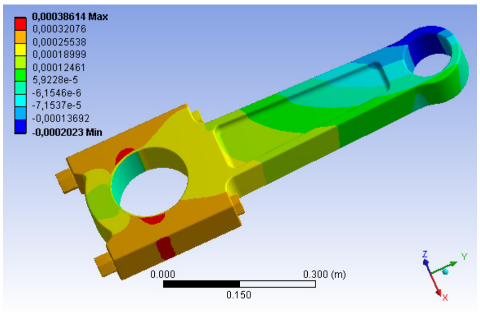
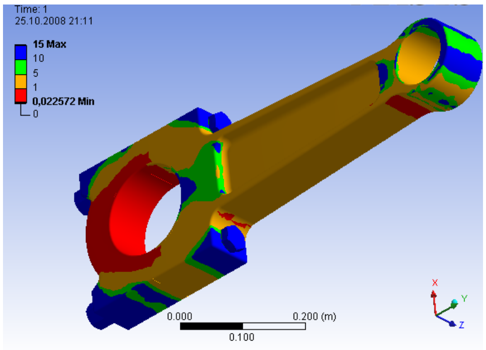


b)

Fig. 4. *The Oy axis displacements a) for the real engine; b)for the obtained model*



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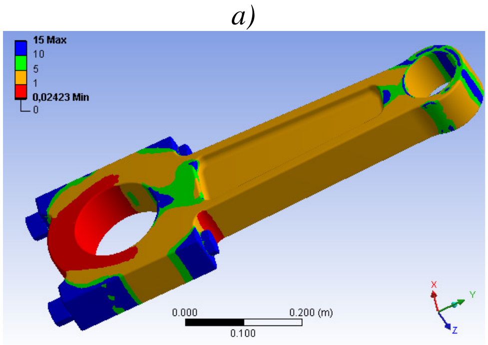

b)

Fig.5. *Safety coefficient a)For the real engine; b)for the obtained model*

5. Conclusions

First, according to the results achieved from the first set of the structural analisys, it was necessary to modify the connecting radius for the connecting rod, in the case of the increasing value of the compression ratio to 14,208, beacause of the stresses concentrators.

At the end, the results show a variation of the safety factor from a minimun of 0.0225, corresponding to a value of the compression ratio of 12,5 to a minimum of 0.0242 for a value of 14,208. Therefore, we can condiser that the connecting rod will undertake the stresses generated by the superior pressure value without major risks.

References

1. Anastase, P.: *Instalații energetice naval.* Constanța. Ed. Muntenia & Leda, 2000.
2. Dragalina, A.: *Motoare cu ardere internă,* Vol. 2. Constanța. Ed. Academiei Navale ”Mircea cel Bătrân”, 2003.
3. Dragalina, A.: *Calculul termic al motoarelor diesel navale*. Constanța. Ed. Muntenia & Leda, 2002.
4. Ristea, M.: *Studiul posibilităților de corectare a raportului de comprimare, raport de cercetare stiintifica.* Bucuresti. Academia Tehnică Militară, 2008.
5. *** - *Documentația motoarelor* ALCO.
6. *** - MCE – 5 Tech News, Februarie 2006.