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PROPOSED DESIGN OF TA*BLE AND SEAT WORK IN AFBRAMEN WORKSTATIONUSING ULRICH-EPPINGER*

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ABSTRACT

The grinding process that uses the conventional method hasbeen proposed by the process of the concept of their products. But the proposal are stillin the conceptual research so it needs to be continued by the process that focused on detail design. The research object is the afbramen workstation in Special Vehicles Division, PT PindadPersero. The new concept of table and seat work is an improvement from the previous measurement.This study was conducted as the further developmental stage for the table and seat workfeatures using theulrich-eppinger method. In the final phase of the development, the tables and seat work are tested using Von Mises and Factor of Safety (FOS). Based on the research, the result for Von Mises test is 0.005-2.824 MPafor table work, 0.001-17.674 MPa for tiang utama, and 0.4 Pa-0.765 MPafor tiang gerak. Also, the result for FOS simulation appeared to be considerable, as the value comes as 83.21 to a table work, 13.3 for tiang utama, and 307.07 for tiang gerak. Those amount is much less than the yield strength for ST37 which is 235 MPa and the value of FOS is greater than 1 so that the table and seat work are good to develop.

Key words: grinding process, detail design, ulrich-eppinger

1. INTRODUCTION

PT Pindad (Persero) is the state-owned company (BUMN) which engages in weapon productions for the army. The goods production divided in several Division, and one of them is Special Vehicles Division which produces the Anoa 6x6. The steps to produce the compiler components of Anoa 6x6 includes the three processes, there are cutting, grinding, and welding. After the raw material cut, the component distributed to the grinding (afbramen) workstation and when it finished, the component will distribute to the welding workstation to be assembled.

The problem has been found in grinding process, to which the operators had suffered the awkward posture while grinding the components in max 2-3 hours per-lot. That posture costs the operator 7 point for RULA which means that the table and seat work as a posture's support should be changed right away. The measurement of the ideal specification of table and seat work for the operator has done in the previous research using RULA method.

Table 1.1Technical Specification of Table and Seat Work

Technical Specification	Dimension (cm)
Table height from the floor	73.7
Backrest height on table	73.7
Table surface height	75.7
Foot step height	18.5
Backrest lenght on table	86.6
Backrest width on table	38.2
Table surface lenght	38.2
Table surface width	38.2
Minimum height chair	44.5
Maximum height chair	54.6
Length of seat	37.1
Width of seat	20.25

The result indicates that the research needs to be continued by actualizing the raw specification into the analytic prototype to meet the needs of the operator. The design of table and seat work will be completed by generating the additional feature to help operator in dischanging the existing work activities. Thus, this research will take part in detail design of table and seat work in grinding workstation.

2. THEORETICAL BACKGROUND

2.1 Ulrich-Eppinger Product Development

The Ulrich-Eppinger product development mostly define the product

development processes that oriented in the customer needs. This method are structured, which means it generally provide a step-by-step approach and often provide templates for the key information systems used by the team. There are six phase of product development process such as Planning, Concept Development, System Level Design, Detail Design, Testing and Refinement, and Production Ramp-up.[1]

2.2 Finite Element Analysis

In the field of structural analysis, one of the earliest procedures for the numerical solutions of the governing differential equations of stressedcontinuous solid bodies was the finite difference method. In the finite difference approximation of differential equations, the derivatives in the equations are replaced by difference quotients of the values of the dependent variables at discrete mesh points of the domain. After imposing the appropriate boundary conditions on the structure, thediscrete equations are solved obtaining the values of the variables at the mesh points.[2] There are two simulation that will be generated from FEA, the Von Mises analysis and FOS simulation. Von Mises analysis is the stress test for the product that derriven from the energy distortion, which the FOS is the comparation of the material strength to the design load.

2.3 Usulan Perbaikan Desain Meja dan Kursi di Stasiun Kerja Afbramen Dengan Menggunakan Metode Rula (Widawati, 2014)

The previous research is done by Michiko Nur Widawati in PT Pindad Persero. The research objection is to prevent the operator from the musculoskeletal risk by giving the improvement specification for table and seat work that support the grinding's activity.

The method that has been used in this research is RULA (Rapid Uper Limb Assessment) according to WISHA (Washington Department of Labor and Industries) which define that the movement of the back to the flexion arch more than 30^0 for 2 hours more per day can result in the awkward posture. So the posture should be fixed by calculating the anthropometry of the operator to be implemented in table and seat work.[3]

3. RESEARCH METHOD

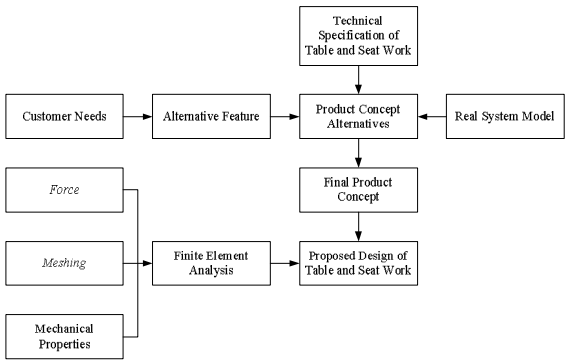


Figure 3.1 Research Method

The specification of table and seat work has been set and used as an input for generating the detail design and the feature of the table and seat work as well.Then, the variabel of customer need will be identified using the ulrich-eppinger product development. The concept design is undertaken to gather all the possible alternative of design that fullfilled all the specification target. The product concept alternatives will be selected using the criteria selection that already based on the customer's need so that the final concept will be generated.

The choosen of concept product will be designed using the SolidWorks 2012. Then there will be tests by using finite element for the choosen design to make sure that the design is feasible to be develop.

4. RESULT AND DISCUSSION

The final concept of table and seat work is the design that combines both of the table work and storage components so that the work space for the operator can be wider than the other concepts. As for the arches shape at the right side on the table work is aimed to facilitate the grinding process so that the operator can grind the component in the middle of the table. There is the grinding residue

storage at the bottom of the arches to prevent the residue from falling to the operator's leg and the floor.
Then, there are a tools storage that positioned in front of the right side of the operator. The placement of the tools storage is derriven from the needs of getting the tools by the right hand, so it will be easier for the operator to take the tools for grind and to place it back to the tools storage.

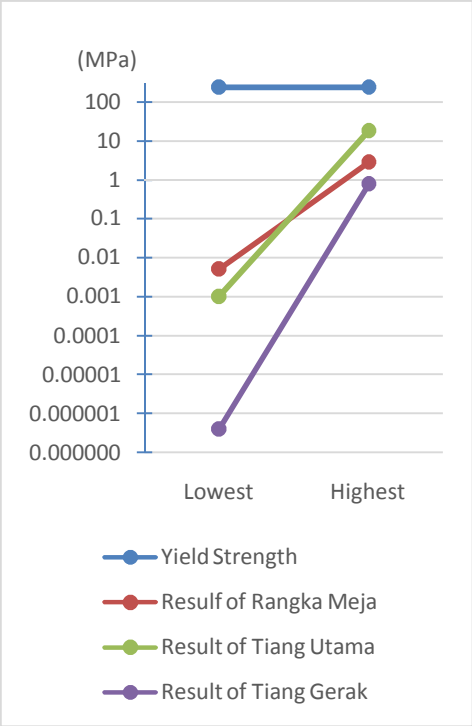


Figure 4.1 Result of Stress Test

According to the Figure 4.1, the stress has a small impact with the structure of rangka meja, tiang utama, and tiang gerak. As it shown in the chart, the rangka meja gets 0.005-2.824 MPa for its stress level, as the highest number happens in the storage components area. Its the same for tiang utama and tiang gerak which results 0.001-17.674 MPa and 0.4 Pa-0.765 MPa. These number is still far away from the yield strength of the material, which results 235 MPa. It means that the structure is good to be developed.

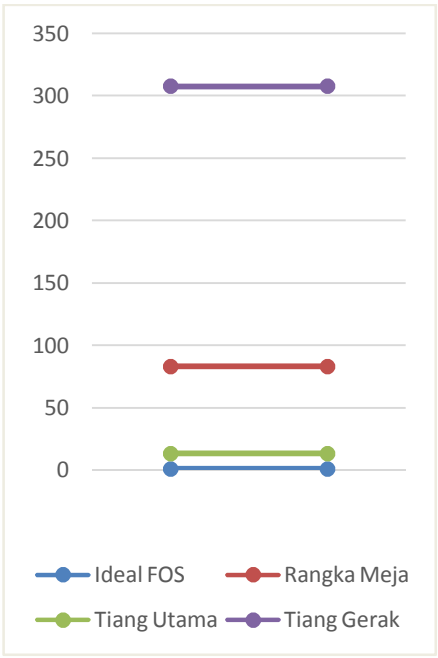


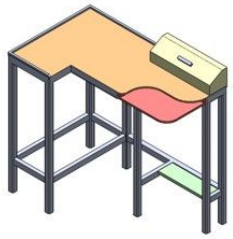
Figure 4.2 Result of FOS Simulation

FOS is one of the important simulation to know if the design load surpasses the material strength or not. As shown in Figure 4.2, the ideal FOS should be 1 or can be more than 1. However, the rangka meja, tiang utama, and tiang gerak has larger FOS point than the ideal point of FOS which is 83.21, 13.3, and 307.7. The larger the number shows that the material still in the elastic phase of deformation and generally cost more. But we can't reconsider the other material as the PT Pindad itself ordered that its better to use the material that they already have in the their factory.

5. CONCLUSION

The final concept of table and seat work is designed by the analitical prototype which is shown in Table 6.1 and 6.2.

Table 6.1 Final Specification of Table



Karakteristik Teknis	Satuan	Nilai
Panjang meja kerja	cm	86,6
Lebar meja kerja	cm	38,2
Tinggi meja kerja	cm	71
Panjang wadah alat kerja	cm	48
Lebar wadah alat kerja	cm	13
Tinggi wadah alat kerja	cm	15
Panjang wadah komponen	cm	52
Lebar wadah komponen	cm	52
Tinggi wadah komponen	cm	71
Panjang pijakan kaki	cm	50
Lebar pijakan kaki	cm	11,1
Tinggi pijakan kaki	cm	18,5
Kekuatan meja	N	363

Table 6.2 Final Specification of Seat Work

Karakteristik Teknis	Satuan	Nilai
Panjang kursi	cm	37,1
Lebar kursi	cm	20,25
Tinggi kursi (*adjustable*)	cm	44,5-54,6
Panjang sandaran kursi	cm	45
Lebar sandaran kursi	cm	4
Tinggi sandaran kursi	cm	54
Panjang sandaran lengan	cm	14
Lebar sandaran lengan	cm	8
Tebal sandaran lengan	cm	2
Kekuatan kursi	N	1315

The choosen concept of table is concept D which has a drawer as a tool storage, and an arch-shape of table work. This feature is designed to help the operator to work in the middle of the table as he needs to working on the edge of the table and can easily take and store the tools back to the tool storage.

As for the result of the stress test, the rangka meja, tiang utama, and tiang gerak has the least number of the stress level comparing to the yield strength of the ST37, which is 0.005-2.824 MPa, 0.001-17.674 MPa, and 0.4 Pa-0.765 MPa to 235 MPa. It means that the design are safe to be develop.

For the FOS simulation, most of the result from the rangka meja, tiang utama, and tiang gerak exceed the ideal FOS, which is 83.21, 13.3, and 307.7. This result means that the material strength is more capable to handle the design load.

6. REFERENCES

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