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# OUTCOME BASED LAB TASK REPORT

# Crash Test Simulation Analysis Of a Four Wheeler

**OUTCOME BASED LAB TASK REPORT**

*Submitted by*

**MANIKANDAN A**

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**September 2023**

## DECLARATION

I affirm that the lab task work titled **" Crash Test Simulation Analysis of a Four Wheeler"** being submitted as the record of original work done by us under the guidance of Mr.Raja T, Assistant Professor, Department of Automobile Engineering.

(Signature of candidate)

MANIKANDAN A

201AU116

I certify that the declaration made above by the candidates is true.

(Signature of the Guide)

RAJA T

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# OUTCOME BASED LAB TASK
## RUBRICS FORM

**Student name:**
**Register number:**
**Name of the laboratory:**
**Name of the lab handling faculty:**
**Name of the task:**
**Experiments mapped:**

1. 
2. 
3. 

| S.No | Rubrics | Maximum reward points | Awarded reward points |
|---|---|---|---|
| 1 | Design of test track | **20** | |
| 2 | Input Parameters | **20** | |
| 3 | Boundary conditions | **30** | |
| 4 | Test Parameter | **30** | |
| 5 | Output Results | **30** | |
| 6 | Project report | **20** | |
| | **Total** | **150** | |

Signature of Faculty with name and date

# INTRODUCTION:

- Crash test results are vital for evaluating the safety and performance of vehicles in different collision scenarios. They provide data on how the vehicle structure, occupant protection systems, and other components respond to impact forces and energy absorption.

- A crash simulation produces results without actual destructive testing of a new car model. This way, tests can be performed quickly and inexpensively in a computer, which permits optimization of the design before a real prototype of the car has been manufactured. Using a simulation, problems can be solved before spending time and money on an actual crash test. The great flexibility of printed output and graphical display enables designers to solve some problems that would have been nearly impossible without the help of a computer.

- Large number of crash simulations use a method of analysis called the Finite Element Method. The complex problems are solved by dividing a surface into a large but still finite number of elements and determining the motion of these elements over very small periods of time. Another approach to crash simulations is performed by application of Macro Element Method. The difference between two mentioned above methodologies is that the structure in case of Macro Element Method consists of smaller number of elements. The calculation algorithm of structure deformation is based on experimental data rather than calculated from partial differential equations.

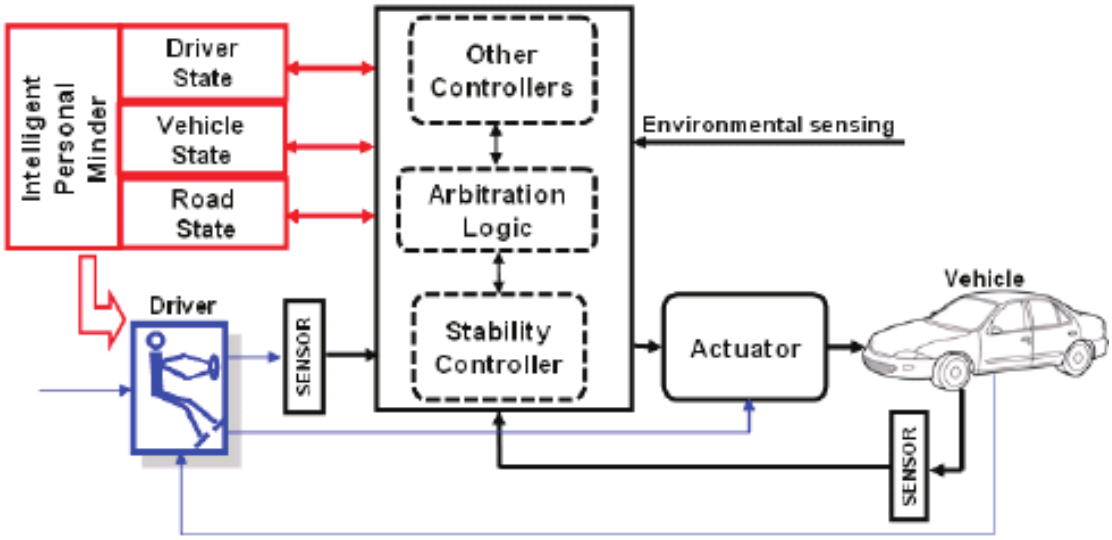
## TITLE OF THE TASK:

- Crash Test Simulation Analysis Of a Four Wheeler.

## OBJECTIVE OF THE TASK:

- The Objective of the task is to study the crash test simulation analysis of a four wheeler.

## OVERALL BLOCK DIAGRAM OF THE TASK:




## METHODOLOGY PROPOSED:

- A crash simulation is a virtual recreation of a destructive crash test of a car or a highway guard rail system using a computer simulation in order to examine the level of safety of the car and its occupants. Crash simulations are used by automakers during computer-aided engineering (CAE) analysis for crashworthiness in the computer-aided design (CAD) process of modelling new cars. During a crash simulation, the kinetic energy, or energy of motion, that a vehicle has before the impact is transformed into deformation energy, mostly by plastic deformation (plasticity) of the car body material (Body in White), at the end of the impact.

- Data obtained from a crash simulation indicate the capability of the car body or guard rail structure to protect the vehicle occupants during a collision (and also pedestrians hit by a car) against injury. Important results are the deformations (for example, steering wheel intrusions) of the occupant space (driver, passengers) and the decelerations (for example, head acceleration) felt by them, which must fall below threshold values fixed in legal car safety regulations. To model real crash tests, today's crash simulations include virtual models of crash test dummies and of passive safety devices (seat belts, airbags, shock absorbing dash boards, etc.). Guide rail tests evaluate vehicle deceleration and rollover potential, as well as penetration of the barrier by vehicles.

## ALGORITHM/CODING:

- In the years 1970 attempts were made to simulate car crash events with non-linear spring-mass systems after calibration, which require as input the results of physical destructive laboratory tests, needed to determine the mechanical crushing behavior of each spring component of the modeled system. "First principle" simulations like more elaborate finite element models, however, need only the definition of the structural geometry and the basic material properties (rheology of car body steel, glass, plastic parts, etc.) as an input to generate the numerical model.

- The origins of industrial first principle computerized car crash simulation lies in military defense, outer space, and civil nuclear power plant applications. Upon presentation of a simulation of the accidental crash of a military fighter plane into a nuclear power plant on May 30, 1978, by ESI Group in a meeting organized by the Verein Deutscher Ingenieure (VDI) in Stuttgart, car makers became alerted to the possibility of using this technology for the simulation of destructive car crash tests (Haug 1981).

- In the following years, German car makers produced more complex crash simulation studies, simulating the crash behavior of individual car body components, component assemblies, and quarter and half car bodies in white (BIW). These experiments culminated in a joint project by the Forschungsgemeins chaft Automobil-Technik (FAT), a conglomeration of all seven German car makers (Audi, BMW, Ford, Mercedes-Benz, Opel, Porsche, and Volkswagen), which tested the applicability of two emerging commercial crash simulation codes.

- These simulation codes recreated a frontal impact of a full passenger car structure (Haug 1986) and they ran to completion on a computer overnight. Now that turn-around time between two consecutive job-submissions (computer runs) did not exceed one day, engineers were able to better understand the crash behavior and make efficient and progressive improvements to the analyzed car body structure. Computer-aided engineering (CAE) software became lately a norm in the crash test simulation. The combination of Machine learning and CAE tools allowed a much better acceleration of the simulation software. Engineers used ML to predict

- Crash simulations are used to investigate the safety of the car occupants during impacts on the front end structure of the car in a "head-on collision" or "frontal impact", the lateral structure of the car in a “side collision” or “side impact”, the rear end structure of a car in a "rear-end collision" or “rear impact”, and the roof structure of the car when it overturns during a "rollover". Crash simulations can also be used to assess injury to pedestrians hit by a car.

**OUTPUT SCREENSHOT:**

**CONCLUSION:**

- Thus the Crash Test Simulation Analysis Of a Four Wheeler is achieved successfully.

**REFERENCE:**


- **https://www.irjet.net/archives/V5/i8/IRJET-V5I8262.pdf**
- **https://www.ijert.org/research/crash-analysis-for-optimum-design-of-atv-frame-IJERTV9IS100214.pdf**

## PROCESS PLAN:

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### PROCESS PLAN

| Proposed Process Plan | Actual Plan Executed |
|---|---|
| • First open the IPG car maker software in the system.<br>• Then open the analysing area for the enter the data.<br>• Then analyse the data in the software. | • The task executed as per the plan.<br>• The task is executed as per the plan.<br>• The task has executed as per the plan. |

**Skill:** 18AU707-VEHICLE DYNAMICS LABORATORY **Date:**14.09.2023 **Name:** MANIKANDAN A

## REFLECTION SHEET:

# Reflection Sheet

| S/N | Problems | Counter measures | Status |
|---|---|---|---|
| 1. | While entering the data problem was faced. | Discussed with the trainer and solved. |  |
| Date: 14.09.2023 | | Prepared By: MANIKANDAN A | |

**Status Legend :**

| | |
|---|---|
|  | Self-understood and resolved |
|  | Discussed with Trainer and resolved |
|  | Yet to discuss / find solution |