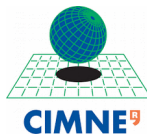


Industrial training

Applus+ IDIADA



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1 Applus+ IDIADA

Applus+ IDIADA is a company that provides engineering and homologation services to the automotive industry worldwide. It is located in *l'Albornar*, near *El Vendrell* (Tarragona).



It was founded in 1971 as the *Institute for Applied Automotive Research* at the University of Catalonia's Higher Engineering School. Then on 1990 it became an independent company belonging to the Regional Government of Catalonia. Nine years later, on 1999, it became a private enterprise, *IDIADA Automotive Technology SA*, belonging 80% to Applus+ and 20% to the Regional Government of Catalonia.

Nowadays, the company has more than 2,100 engineers and technical experts and offices all over the world with a network of subsidiaries and branch offices in 25 countries.

Their activity is mainly focused on engineering services such as passive safety, power train, durability and reliability but also on homologation, product certification and providing ground always offering to the customers a personalized and fast service.

2 Area and Department of the industrial training

The industrial training was performed in the Design Engineering department, in particular in the Commercial Vehicle (CV) team. The Commercial Vehicle (CV) team is

dedicated to the study of bus and coaches superstructure to fulfill with the European regulation R66 and also to perform durability studies to ensure the lifecycle of the vehicles.

All the studies are based on a Finite elements model of the whole vehicle structure. That is, the first steps of every project consist in transform a CAD model into a discretized model of the vehicle that can be used to compute numerically stresses, energy... by:

- Performing a mesh capable of represents accurately the behavior of the structure.
- Applying the corresponding boundary conditions, contacts and loads.
- Defining the appropriate type of analysis and its targets.

A CAE pre-processing tool used to build up the model to study from the CAD. Once the numerical solution is obtained different countermeasures are studied to fulfill with the targets defined for the structure under study by visualizing the results in post-processor software.

2.1 Applicable regulation: Regulation 66

The European regulation R66 of The United Nations Economic Commission for Europe (UNECE) is the regulation compounded by the definition of the different procedures that have to be followed in order to ensure that the superstructure of the buses¹ is correctly designed and consequently it can be homologated by the corresponding institution. Broadly, if the superstructure of the bus does not penetrate into the survival space during a rollover test, it will be correctly designed. The regulation R66 defines the survival space as:

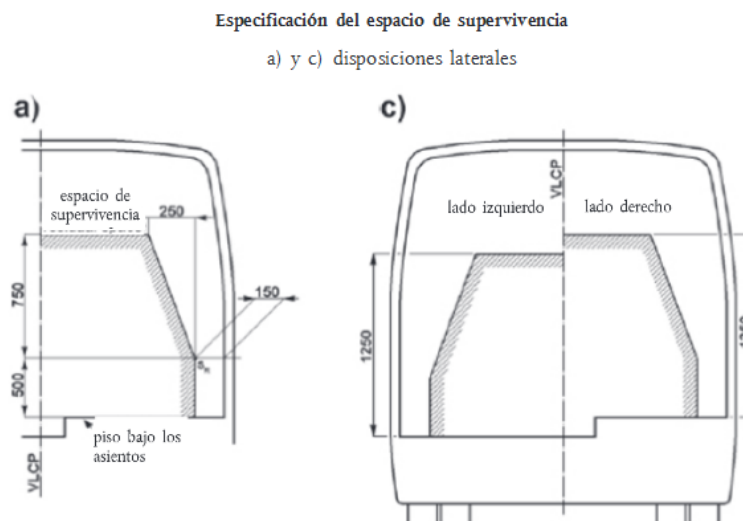


Figure 1: Survival space specification

¹ This regulation applies to 1 floor vehicles, rigid or articulated, which belong to M2 or M3 category, class II or III or class B, for more than 16 passengers.

b) disposición longitudinal

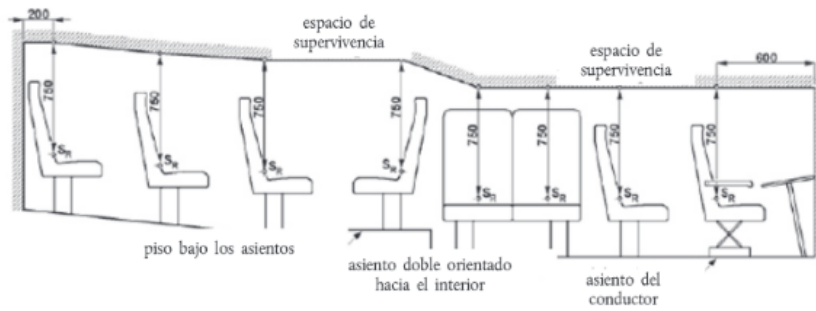


Figure 2: Survival space specification

and the rollover:

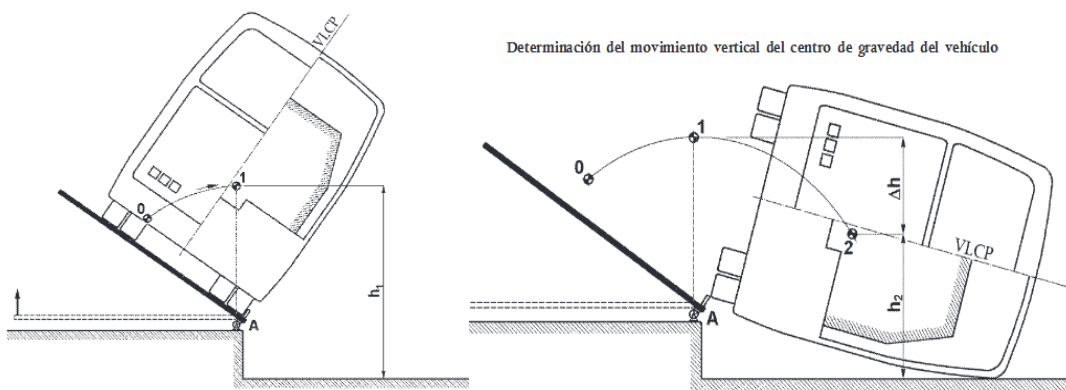


Figure 3: Rollover test specification

Where:

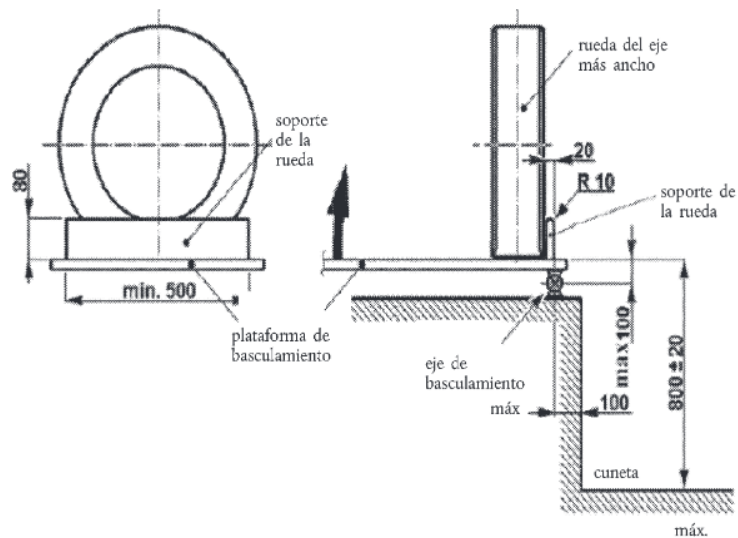


Figure 4: Rollover test specifications

The regulation proposes different methods to verify that this survival space is not invaded by any part of the bus in a rollover situation, from a real rollover to computer simulations of a complete rollover. Among the different procedures described in the regulation, the CV area works with Annex 9 where the rollover test is done virtually.

ANEX 9: Computer simulation of the rollover test of a complete vehicle as equivalent homologation method.

2.2 Fatigue Analysis

The VI team also performs computational fatigue analysis to determine the life cycle of the different components of the bus structure. This type of analysis is performed by quasi-static simulations in the longitudinal, lateral and vertical axis of the bus, that later on, the results are combined to get the behavior of the structure on longitudinal, lateral and vertical. It is an un-couple fatigue analysis. There two main areas to study, the base material and the welds, as the targets not depends only in the material if not the welds need a specific target. These studies help to define prototype or the final design, minimizing the cost of physical tests. obtain the stress values needed to calculate the number of cycles that can support.

3 Tasks performed during the Industrial training

3.1 General Objectives

To apply the skills and knowledge in computational mechanics obtained during the master course to the automotive field, more precisely to the buses and coaches simulation using finite element analysis (FEA). Also the opportunity to work in an engineering environment and get some working experience and knowledge.

3.2 Work Plan and tasks performed

The industrial training schedule was agreed to be from October 16th to January 12th, with working hours from 8:30 to 17:30 Monday to Friday.

During the time spent at Applus+ IDIADA, I was giving support mainly to durability simulations. My tasks where related to the development steps of a bus structure from a durability point of view:

- Assembly in the finite element model different parts of the bus from a CAD model and meshing them appropriately to catch precisely the stresses and displacements
- Report and analyze the results obtained from the fatigue analysis.

But also I had the opportunity to perform small tasks in some of the other projects related to the rollover simulations in order to meet the regulation R66 specifications.

4 Overall assessment

The industrial training has turned out to be very useful and interesting to me. First of all I had the opportunity to apply my theoretical knowledge on Finite Elements, computational mechanics and my engineering vision to solve a real problem and the opportunity to know and get used to the tools and software in the industry working surrounded by professionals with lots of experience.

Finally, it has also given to me the opportunity to work in a leader company in the automotive sector, see how it works internally a big company like Applus+ IDIADA, its organization and its human factor.