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Title : Analisys of the dinamyc behaviour of a military vehicle

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ABSTRACT

This work constitutes a degree thesis, developed in collaboration with IVECO-FIAT.

ADAMS has been used to project a new system of suspensions for a light-medium four wheels drive vehicle, already produced by IVECO; this vehicle has been designed to be used in heavy condition.

Over a wide use of ADAMS/View, ADAMS/Solver, ADAMS/Vehicle, and ADAMS/Tire on HP bases 9000, a model of the vehicle has been built in

the actual configuration, and it has been submitted to a simulation of the standard vehicular road.

The results of the simulations have been compared with the results of experimental proofs.

Afterwards the vehicle suspensions system has been changed, and the behaviour of the model has been checked with a wide breed of solutions related to the suspensions' type (Mc-Pherson, Multilink, etc.).

Particularly effective has resulted the possibility to change the physical indicators of the suspensions in not-linear conditions, in order to estimate the dynamic behaviour of the vehicle in different configurations.

The possibility to watch on the monitor the animation of the model during the simulations, in order to verify directly the correct operation of all mechanism, has been greatly appreciated.

So it has been possible to obtain, in a short time, a great number of theoretical results, such as accelerations, forces, etc., affecting any point of the model. This has permitted a rapid, precise and very exciting projecting.

During the training phase for the use of ADAMS, the support of "Mechanical Dynamics Italy" has been remarkable, in the person of Ing.Daniele Catelani.

At the "Politecnico" of Milan is always greater the number of researchers using ADAMS for simulations of the behavior of any type of mechanism seen the excellent results achieved till now.

ANALISYS OF THE DINAMYC BEHAVIOUR OF A MILTARY VEHICLE

1. COMPANY DESCRIPTION

The "Politecnico" of Milan is one of the greatest Engineerings Schools in Italy.

In this university the "Department of Mechanics" develops the activity of research in mechanical constructions, in resistance of materials, in systems' mechanics and in terrestrial vehicles.

Several different experiences are developed here, in closed relationship with industry; expecially, our group is part of the "Terrestrial Vehicles Department", that attends to the formulation of analitycal models of the rotors, and of railway and road vehicles.

2. ADAMS SIMULATION

The ADAMS dynamic simulation code has been employed to study the dynamic behaviour of the IVECO 40.10 WM, a medium-light vehicle adhibited to transport of military troops.

It's a 4-driving-wheels vehicle, and the disposition of its mechanical organs follows a classical scheme:

- frame made up of bolted together spars and cross-bars
- front-wheel suspensions with flexible quadrilateral indipendent wheels
- rear-wheel suspensions with non-flexible axle and leaf springs.

The goal of the aforementioned study was to design a new type of suspension, in order to guarantee a higher comfort to passengers while mantaining a high mobility on rough paths.

ADAMS allowed the characterization of the vehicle's dynamic behaviour through the formulation of a model in non-linear conditions, a model that had to move along a standard path.

The comparation of the simulation's results against the data extracted from an experimental test allowed to judge the accuracy of the analysis, and to modify again the suspension type used in the model.

3.MODEL CONSTRUCTION

Every significant part was schematized with large use of the graphic interface (ADAMS-VIEW); the graphic and inertial characteristics were assigned, and so the various bounds characterising the vehicle structure.

A special care was posed to the suspensions construction, rigorously reproducing the kinematism that characterizes them and the frame structure.

The frame was schematized with a technique akin to the finite elements modellation; this because it was unrealistic to consider as a single rigid body a structure made up with bolted together spars and cross-bars; in fact the frame was subdivided in 25 parts, which exchanged BEAM-type forces. In ADAMS the "BEAM" force defines a constant section beam. This element is

apt to transmit forces and torques between parts, perfectly agreeing with the "Timoshenko" beam theory.

With the tires - apart form the graphic visualization system, which reproduces them following their real geometry - was used a linear schematization, given by PIRELLI.

The non-linearity of the bounds between force and relative translation of the elastic suspension elements, and between force and damper velocity, was implemented in ADAMS indicating a series of points, interpolated through a "SPLINE"-type function.

The complete model of the vehicle, having 163 degrees of liberty, was then passed through a dynamic simulation, referring to the CRYSLER II hole, covered with a 5 Km/h velocity. The following illustration show the resulting data (the diagram show the acceleration of the vehicle's baricentrum).

4.EXPERIMENTAL TEST RESULTS

Collaborating with the "Testing" of the IVECO-FIAT factory in Turin, an experimental test was organized, in order to obtain a checking relating to theorical foreseeings about the dynamic behaviour of the IVECO 40.10 WM, formulated after the aforementioned simulations.

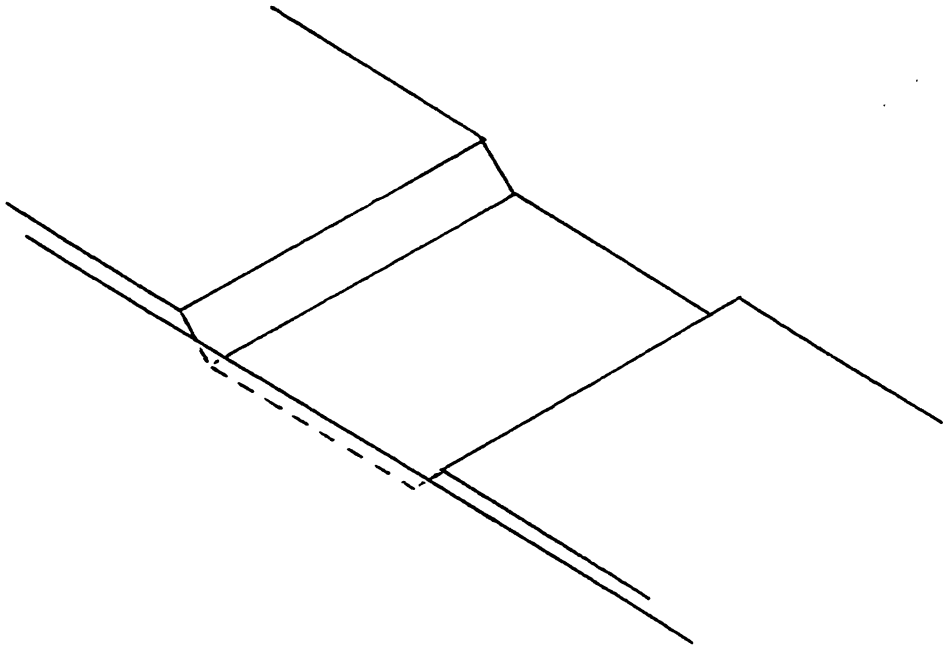
The vehicle was suitably instrumented using induction accelerometers, mounted near the front and rear dampers connections, and on the frame cross-bar near the baricentrum.

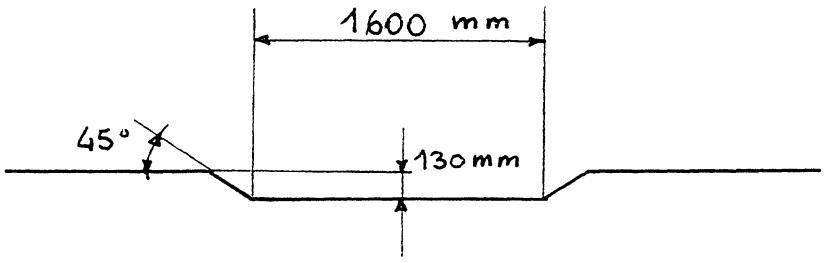
The test was conducted on a CRYSLER II course, with a 5 Km/h velocity.

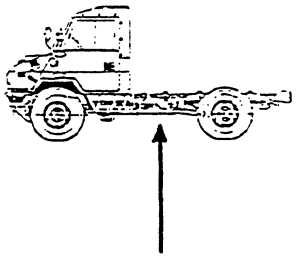
The experimental test results have been compared with the theorical foreseeings obtained from the dynamic simulations. The comparation showed that the measured acceleration level of the baricentrum is very near to the levels calculated with the ADAMS model

(maximum peak: real: 5.8 m/s^2; ADAMS: 6 m/s^2).

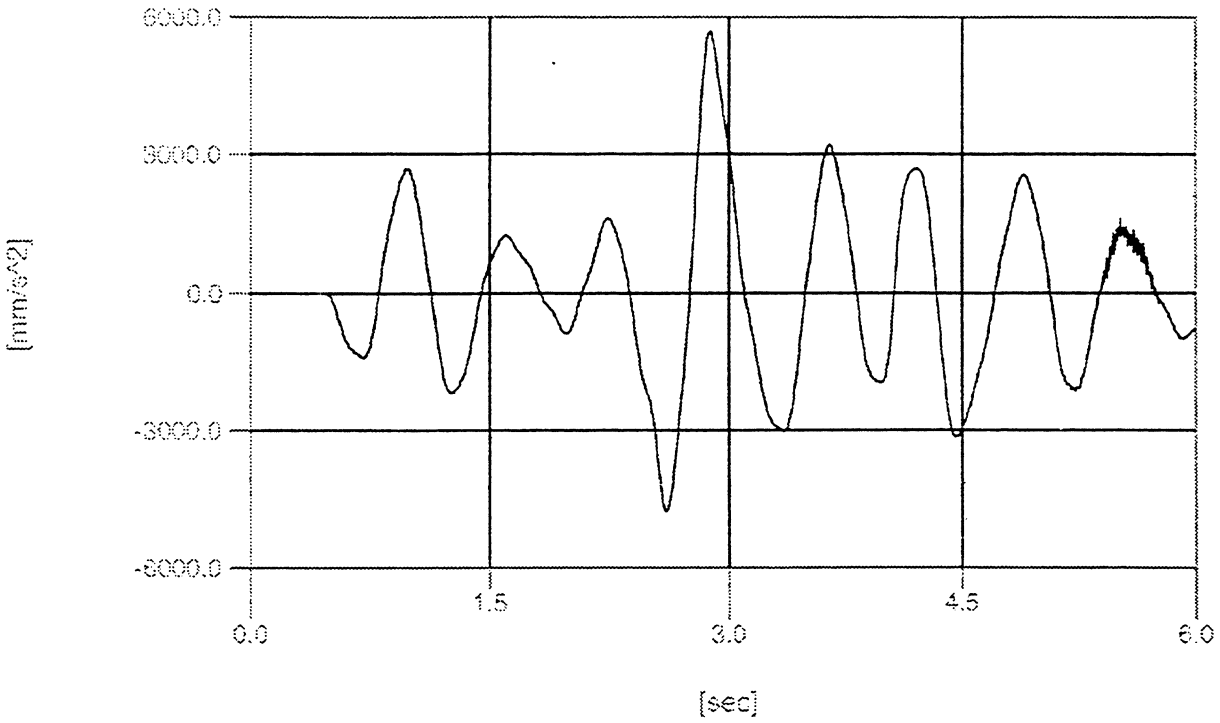
BUCA CRYSLER II

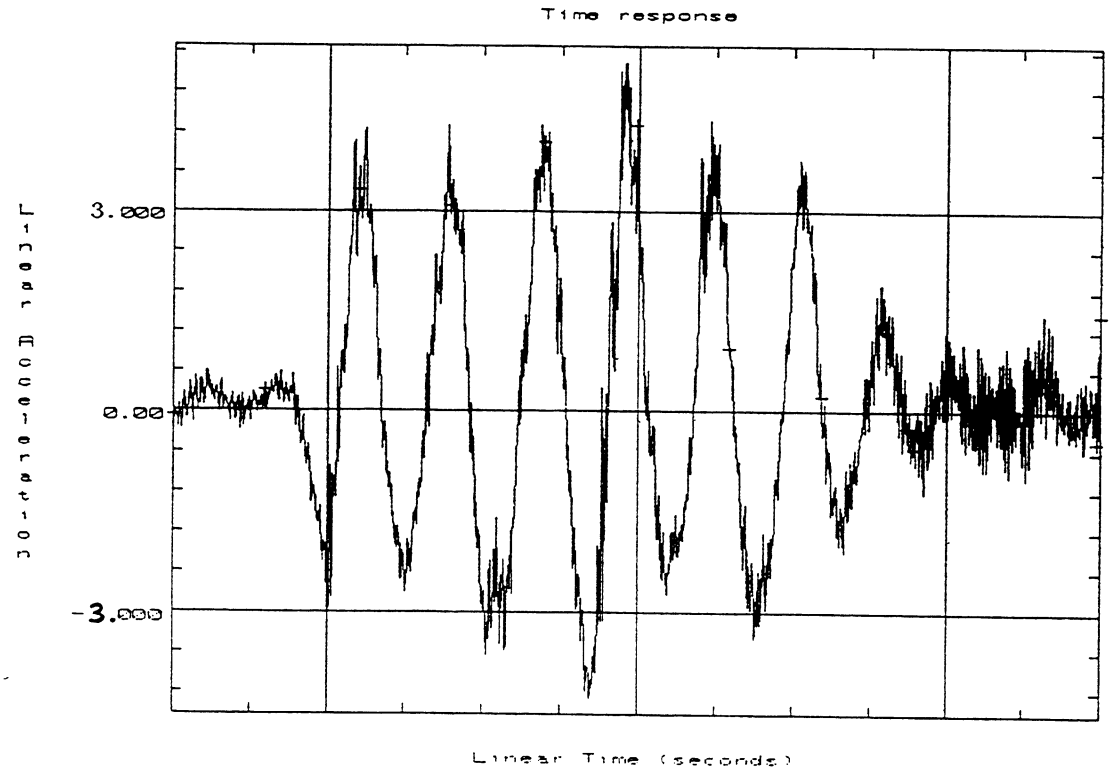






IVECO 40.10 WM (Rigido)





5. CONSTRUCTION OF THE INDEPENDENT-WHEELED REAR SUSPENSION MODEL

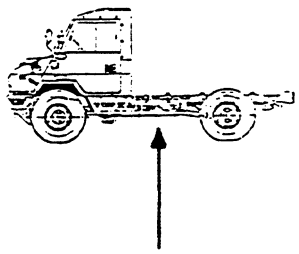
As it was done to realize the schematization of of the vehicle in the version with rigid rear motive axle and with elastic leaf spring elements, a new model of the 40.10 WM has been schematized (through the ADAMS-VIEW graphic interface), provided with McPherson indipendent-wheeled rear suspension. The shock-absorbers of the rear train were moved externally by 200 mm, keeping the original orientation. As elastic element a helicoidal coil has been used, coaxially with the shock-absorber.

The average values chosen for the coil stiffness constant and shock-absorber stiffness constant are the following:

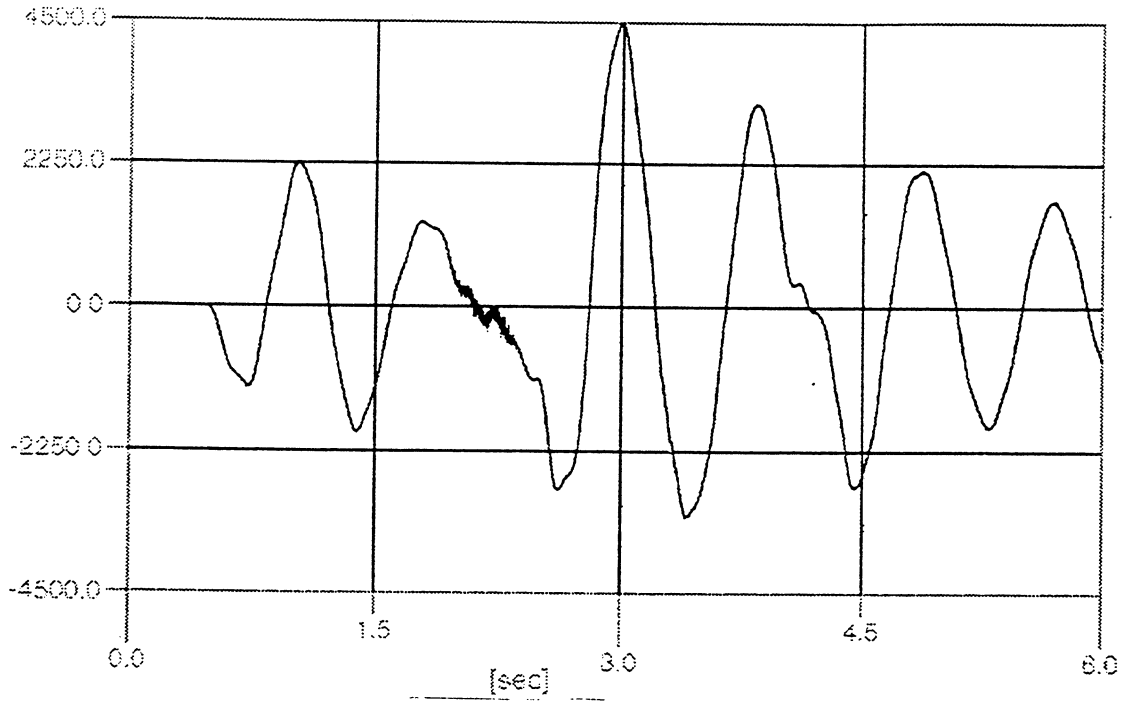
Average damping of the front suspension	4500 Ns/m
Average stiffness of the rear suspension	280000 N/m

The simulation was lead referring again to the CHRYSLER II hole, covered with a velocity of 5 km/h.

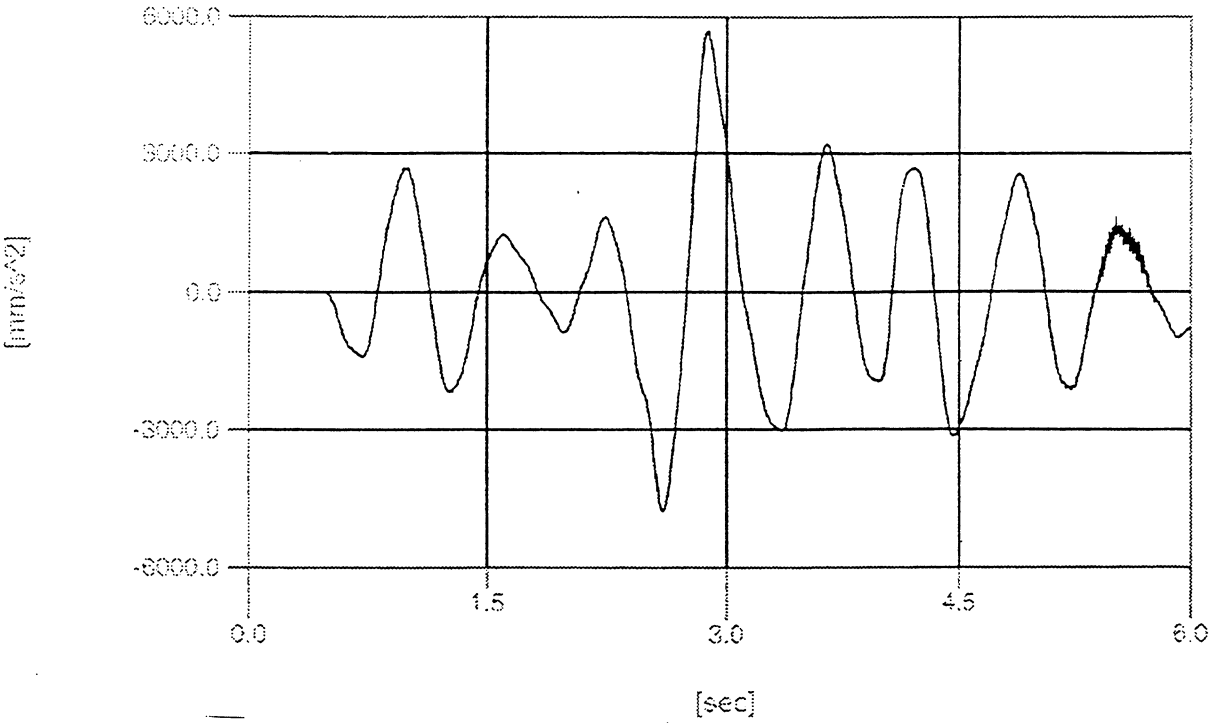
The simulation results are shown in the following figure:



IVECO 40.10 WM (Mcph)



IVECO 40.10 WM (Rigido)



Remember that with these modification the vehicle dynamic behaviour gets better about the maximum acceleration values (about 30%), particularly for the baricentrum.

Considering the comfort improvement, it's clear that the path selected is the right one.

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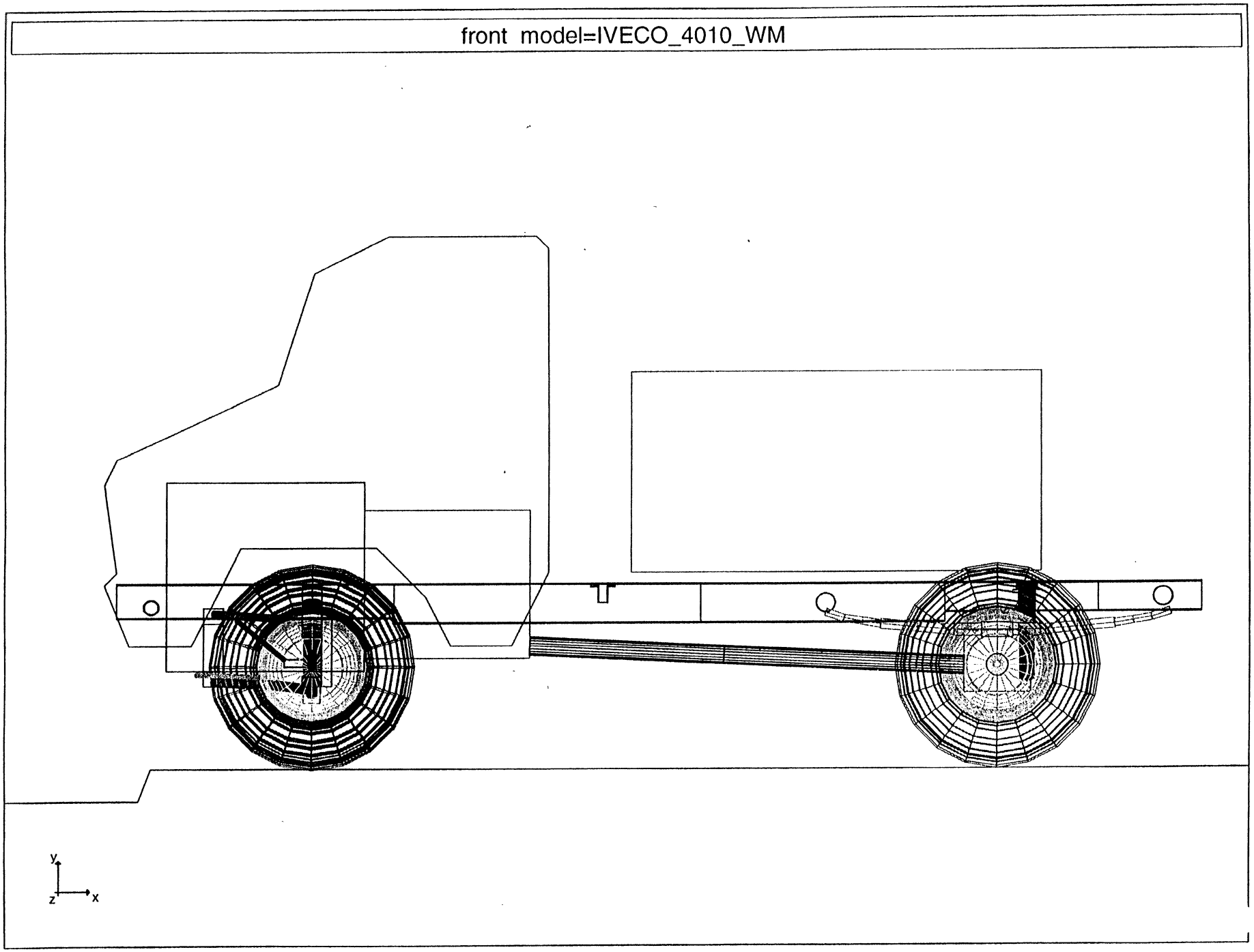

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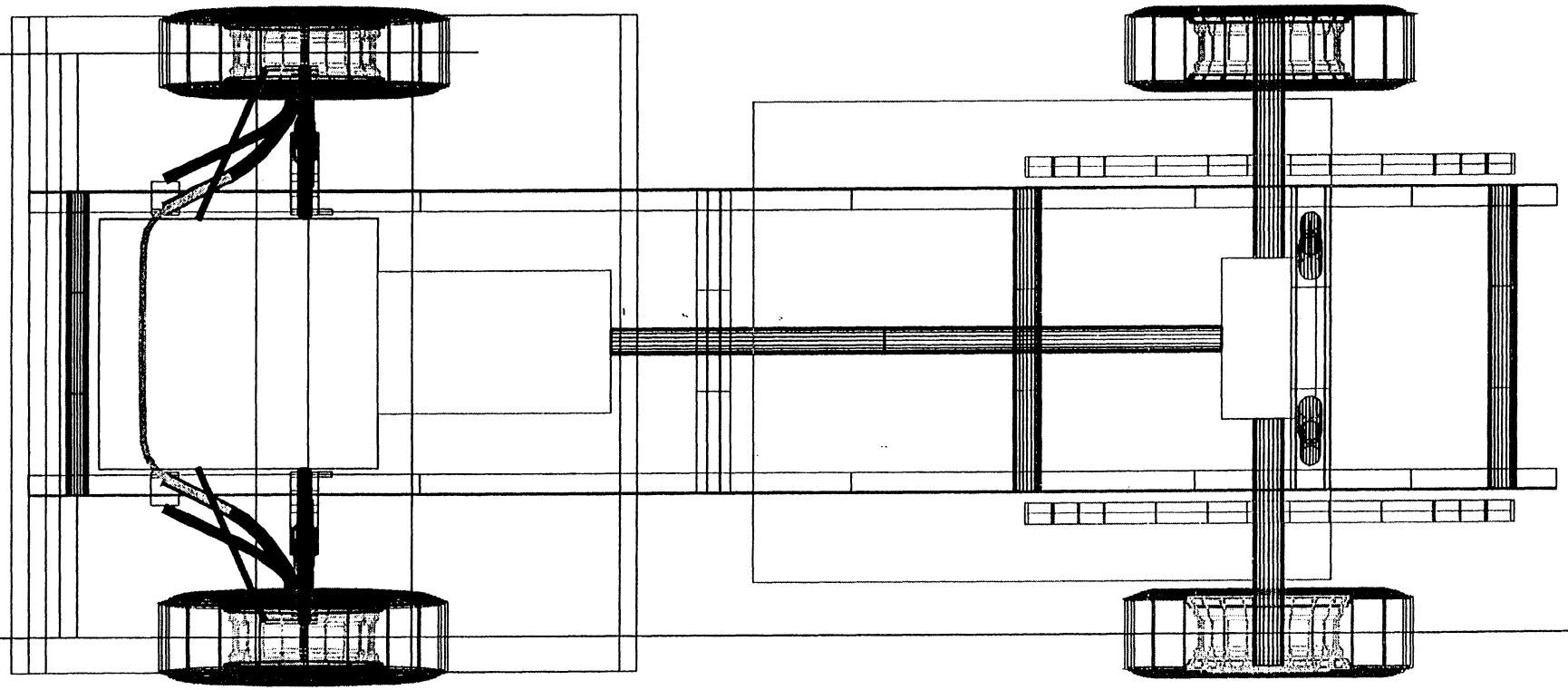

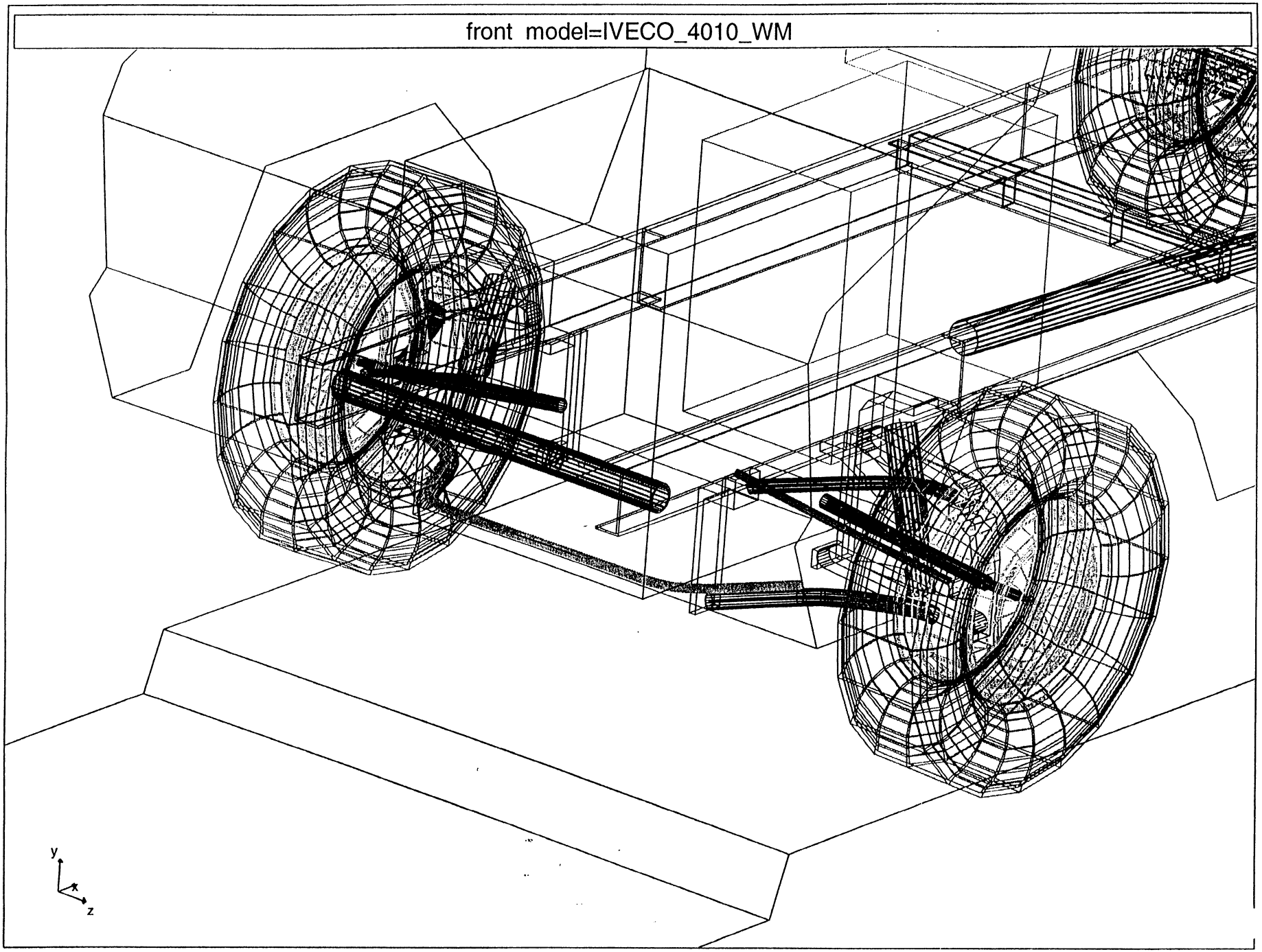
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y
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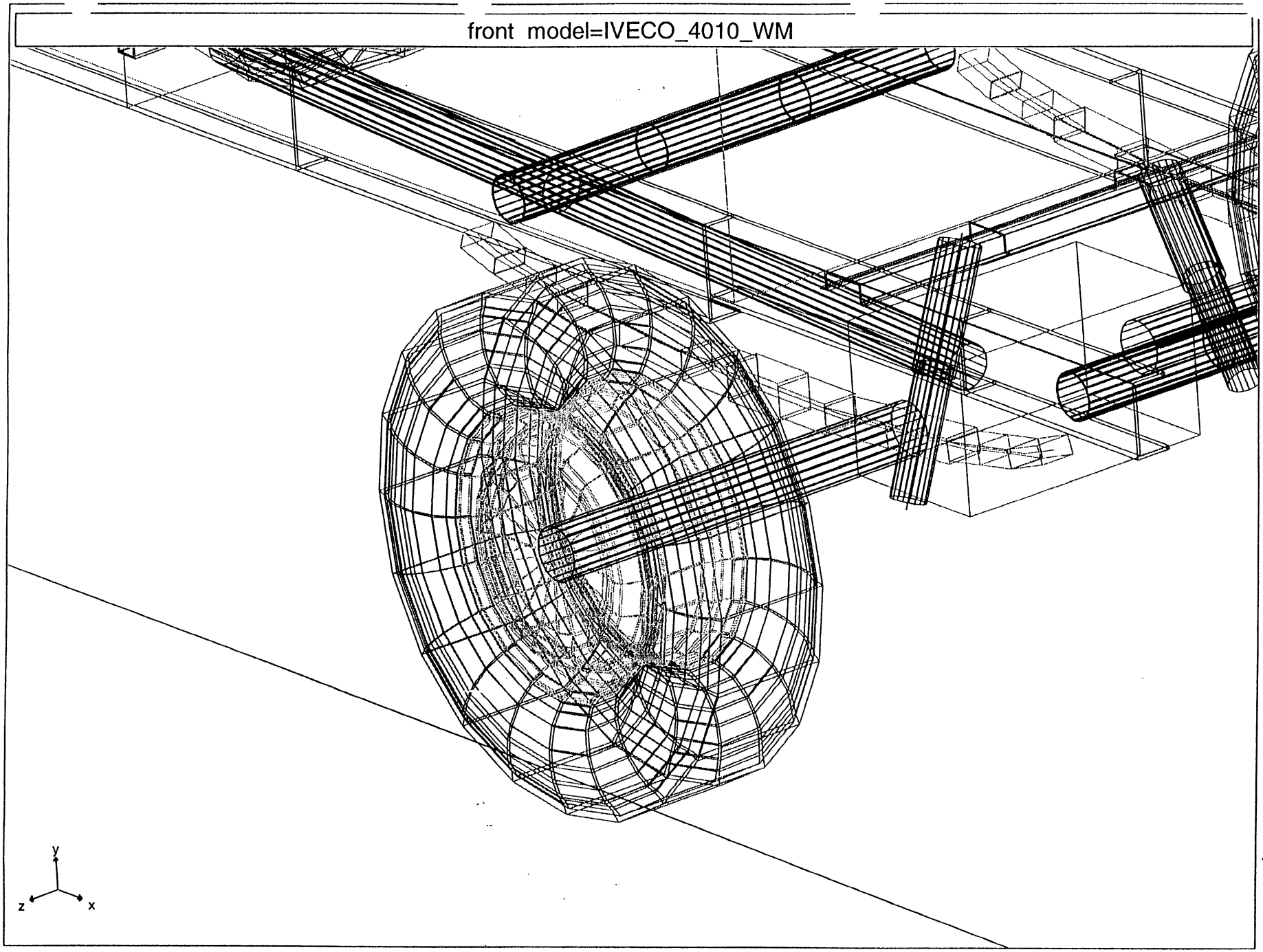
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y
z
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