ASPECTS OF ANALOG THEORETICAL AND EXPERIMENTAL RESEARCH ON THE DYNAMICS OF CABLE CARS

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Abstract: The paper presents the types of cable transport equipment used for goods and tourist to areas for winter sports, and also to have access in areas where is not possible with other means of transport. It highlights the need for cable carriage.
Keywords: cableway, cable, cable transportation

1.INTRODUCTION

Cable transportation is used for quick access to mountains equipped to ski slopes and connects the massive of mountains for tourist attraction. It also represents a means of travel and entertainment, having an important role in the development of mountain tourism (infrastructure tourist altitude resorts), but also for winter tourism.

Experiments remain present in the life of a cable transport installation and after its introduction into production, to check the stability of manufacturing technology, maintain quality and reliability, confirmed during certification (approval). Any changes to a product in mass production involve a review and approval based on appropriate tests.

Therefore, experimental research precede and accompany all stages of the existence of a facility, as an object of economic activity, giving original certificate of conformity with the requirements of the design project and later all certificates of maintaining technical and functional parameters to defaults, so its dynamics to maintain the desired set by the manufacturer and the customer.

2. ASPECTS FROM THE MEASUREMENTS ON THE CABLE CAR

Cable car - bicable car with swinging gait, with usually having a high capacity cabin on each branch. Carrying cables are anchored firmly in the upstream station and stretched to counter the downstream station. Each cable is made from one piece. On line carrier cables stays on pillars of fixed blocks. Pillars are in general made from metal and rarely from concrete. The cable tractor is involved in one of the stations and spread at the opposite station, and rarely used the drive tractor-tension system cable in the same station, the recommendation is that a section of cable between two pillars should not exceed 2000 m, so that not to record a pronounced friction of worn cable on blocks. The cables of which the two cable cars are running sits on pillars at a technological distance, sized in terms of overall installation transport, which is called gauge.

In stations and on routes the tractor cable is led and supported on wheels and rollers drift into stations mounted in blocks pillars [1].

The drive group is equipped with d.c. electric motor that provides the cable car going after a particular program. In all cases there is a group of spare drive powered by an energy source independent of the main engine. Trains roll of cabs are equipped with safety brakes for braking and blocking the carrier cable in the case of towing. If the terrain conditions do not allow lowering the rescue of persons directly to ground, cable cars (Figure 1) are equipped with either a rescue facility along its own line (driving group, cable cabin tractor and rescue), or having a motorcar moving along the carrier cable of the locked cabin blocked on the line [2].

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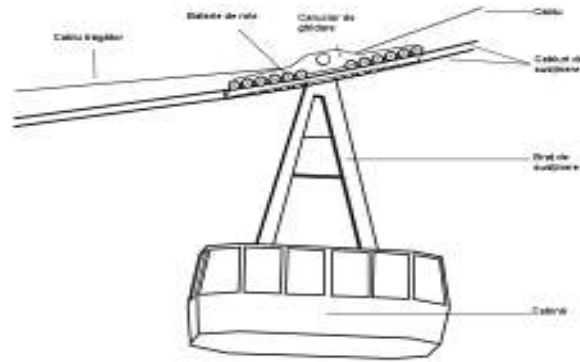
**Figure 1:** The component of a cable car scheme [6]

Since theoretically and experimentally in this paper were aimed to achieve the following objectives:
Analysis by computer simulation of a space trajectory crossing a cable car between two consecutive pillars varying the following parameters: Speed at full scale cable car, acceleration and deceleration time, the tension in cable carrier, depreciation cable car under a gusting crosswind, stability cable car to varying load passengers.


Figure 2: Arrangement of the sensors on the cabin [4]

All sensors were mounted in center of mass of a full loaded cabin for recording all forces and movement filed by the passenger during travel [3].
Used applications was Sensor Insider Pro V 3.1.1, with three-axis acceleration sensor BOSCH DMA222, MMC328X MEMS magnetic field sensor, orientation sensor MEMS magnetic sensor orientation 3, data were recorded using a data acquisition board and processed using an electronic computer (Figure 2).
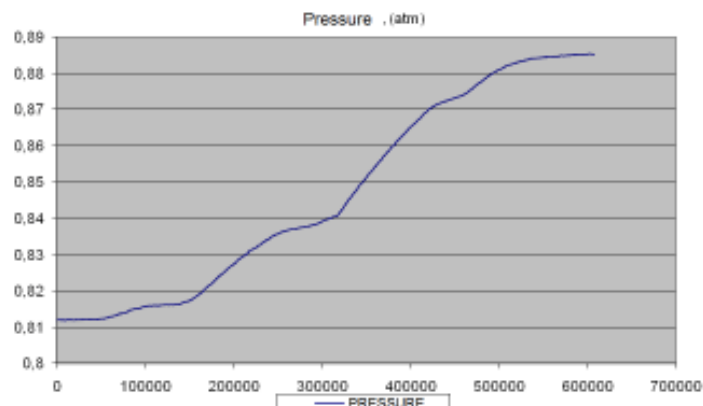
Figure 3: Pressure measurement results Capra Neagra cable car route
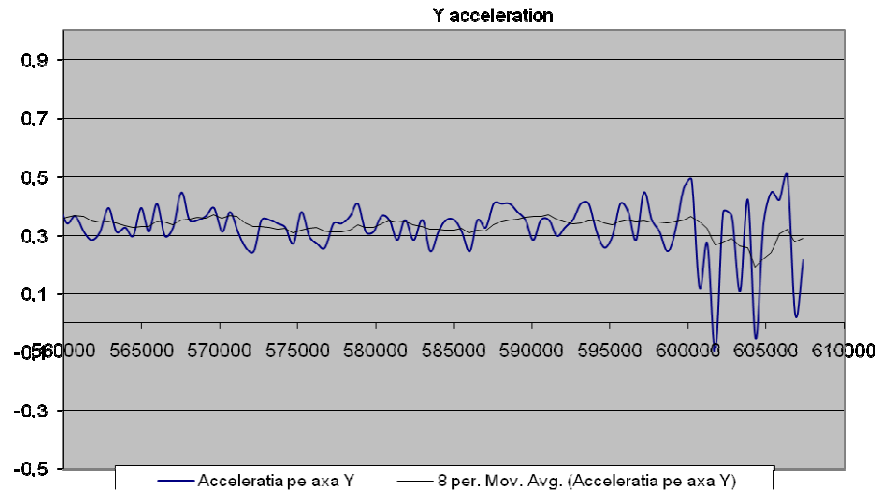
Figure 4: Transverse accelerations measured at the time of entry into the cable car station

The Figure 3 is the graph for the descent atmospheric pressure from 1700 elevation until the cable car station downstream Capra Neagra. And in the following figure 4 can be seen lateral acceleration measured at the downstream station entrance in conditions in which the route were selling gusts of 10 m / s. In case of stalling of in the station, the lateral acceleration from floor level are in the range -0.3...+ 0.3G (Figure 4).

3. ASPECTS FROM THE MEASUREMENTS ON THE 3D MODELL OF A CABLE CAR

Simplified dynamic model (Figure 5) studied has the following characteristics: distance between pillars 260m and 130m height difference, 1:1 cable with total mass of 3000kg. The model has the following variables: the speed of the cable, wind force side of the cylinder damper damping coefficient of rollers mounted between the battery and cabin (in the longitudinal damping). And for simulating air friction was mounted a damper mounted infinitely long the side of the cable car set to be invisible. Maximum wind speed until the cable can move safely is 15 m/s.
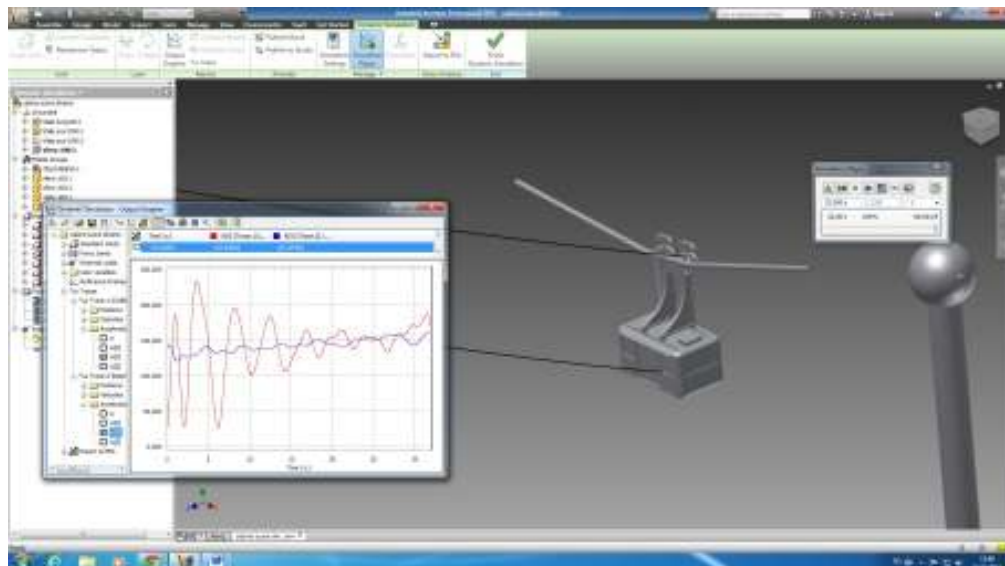
Figure 5: Changes in longitudinal acceleration compared to the variation of the cable car cable longitudinal acceleration (acceleration battery blue rollers, longitudinal acceleration red cable car) [5]

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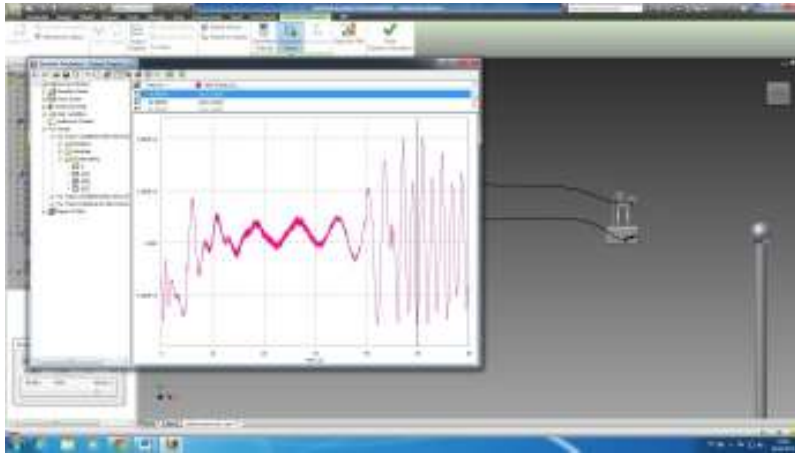
Figure 6: Lateral acceleration felt on the cabin floor

If accelerations felt by the passenger they are less than 0.1 G when leaving the place of high station and about ± 0.2 g for stopping between pillars. Frequency alternating accelerations when stop is 1 Hz to 0.3 Hz when leaving the station downstream (Figure 6).

4. CONCLUSION

As can be seen in the dynamic model studied Autodesk Inventor 10 lateral accelerations recorded on the approximation of the real model for the final stop crossing or intermediate columns have the same value and tend to rise due to the decrease in arm swing while frequency is increasing

When deceleration is apparent in the analytical model and the fact that the cable entering a pronounced longitudinal balance, combined with a vertical oscillation of the whole ensemble.

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