ROLLER GUIDES FOR CANTILEVERED ELEVATORS :

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ABSTRACT :

Further to a paper presented at ELEVCON 90 in Rome which explained advantages of cantilevered elevators , this paper at ELEVCON 92 presents exact data .

The riding characteristics have been recorded up to a speed of 1,7 m/s , employing a tacho generator for travel speed , comparative wattmeter readings for power consumption and vibration transducers . The relevant curves have been recorded and stored by means of a 4 - channel oscilloscope . Corresponding printouts have been produced . The determining parameters are : car frame and loading capacity, wheel diameter of rollerguides , material of wheel tyres and employment of single - or tandem wheels .

INTRODUCTION :

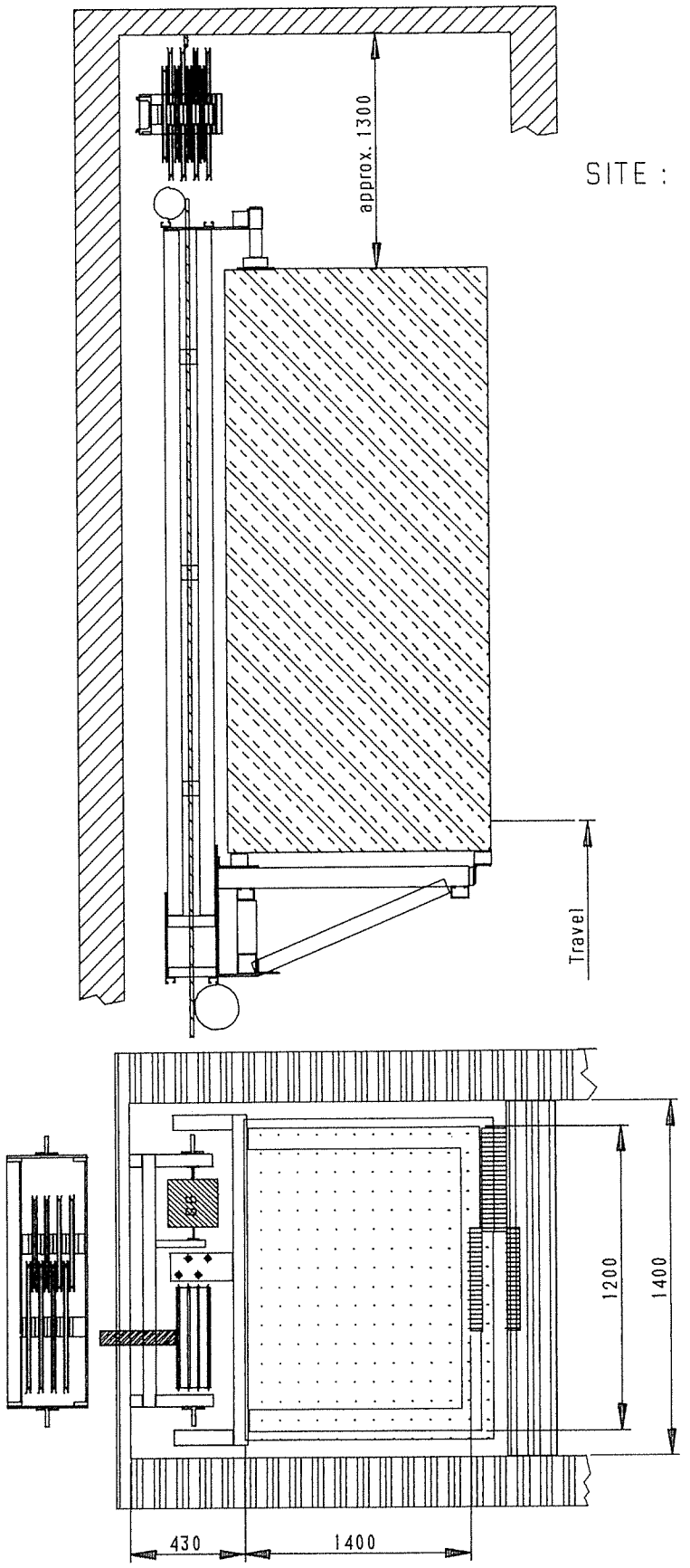
As already mentioned in Rome , placing machine rooms on top and above the hoistway is generally discouraged in Middle European countries . The géneral building conception for built - up areas would not permit such a penthouse arrangement .

We have also learned in the meantime , that in Japan official legislation forbids to exceed building heights which conflict with the SUN SHADOW ANGLE rulings . A machine room on top of a hoistway essentialy eliminates an entire floor .

In modern office buildings with ten or more floors and corresponding elevator carrying capacities , machine rooms above the hoistway are omitted for architectural reasons . Think of the many glass structures , not only in shopping buildings , but also in many office buildings open to the general public . It is often very difficult in such buildings to place rope sheaves above the hoistway within the car area and in accordance with code requirements . A considerable overtravel is required for the commonly used travel speed of 1,6 m/s .

And last not least : a machine room below and adjacent to the hoistway in many respects offers advantages to the elevator manufacturer: repair work, replacement of winding gear.....
and it has also advantages for the resident and developer: most of the noise generated by an elevator is retained in the basement rooms. No costly motorroom above the hoistway.....

It can not be denied, that up to the medium capacity and performance range backpack elevators have certain advantages over centrally guided units, This applies in particular to layouts with driving units arranged below and adjacent to the hoistway.



SITE : DUISBURG - HAMBORN

8 PASSENGER ELEVATORS

630 kg x 1,0 m/s

Within a 1400 mm x 2000 mm hoistway , the required clear car area was 1200 mm x 1400 mm -- satisfying the requirements for disabled persons . The car door and part of the hoistway door area has to be added .

With our suggested layout , a 400 mm clearence behind the car would be adequate for the back pack drive block .The traction sheave and also the counterweight would be placed within the centre line of the car guide rails .The supporting car frame extension for accepting the car ropes is placed approximately halfway between the car rails and within the gauge line . All rail brackets would be designed to hold car - and counterweight guide rails ; a considerable advantage for the installation work . Because the entire drive system would be placed between the car guide rails , it is advisable to reverse the car guide rails to face outward .

Of course, the drive may be accommodated in a proper downstairs machine room, adjacted to the hoistway, with 2:1 roping and an underslung car, Apart from many rope deflections and time consuming installation work, the increased rope speed results in a lot of disadvantages additionally . Anyway , it is impossible to get the centrally guided car sling elevator into the same area .

In comparsion to centrally guided car slings all cantilevered elevators retain two major problems :

a) The excentric placement of the load exposes the car guide rails to bending and torsion strains , which subsequently affect guide rail clamps , guide rail brackets and also the required number and design of guide rails brackets in the hoistway . Today it is no problem at all fasten guide rail brackets onto supporting hoistway walls ; with modern wall plugs and inserted anchor rails , wihch can cope with lolads far in excess of those occuring with elevators .

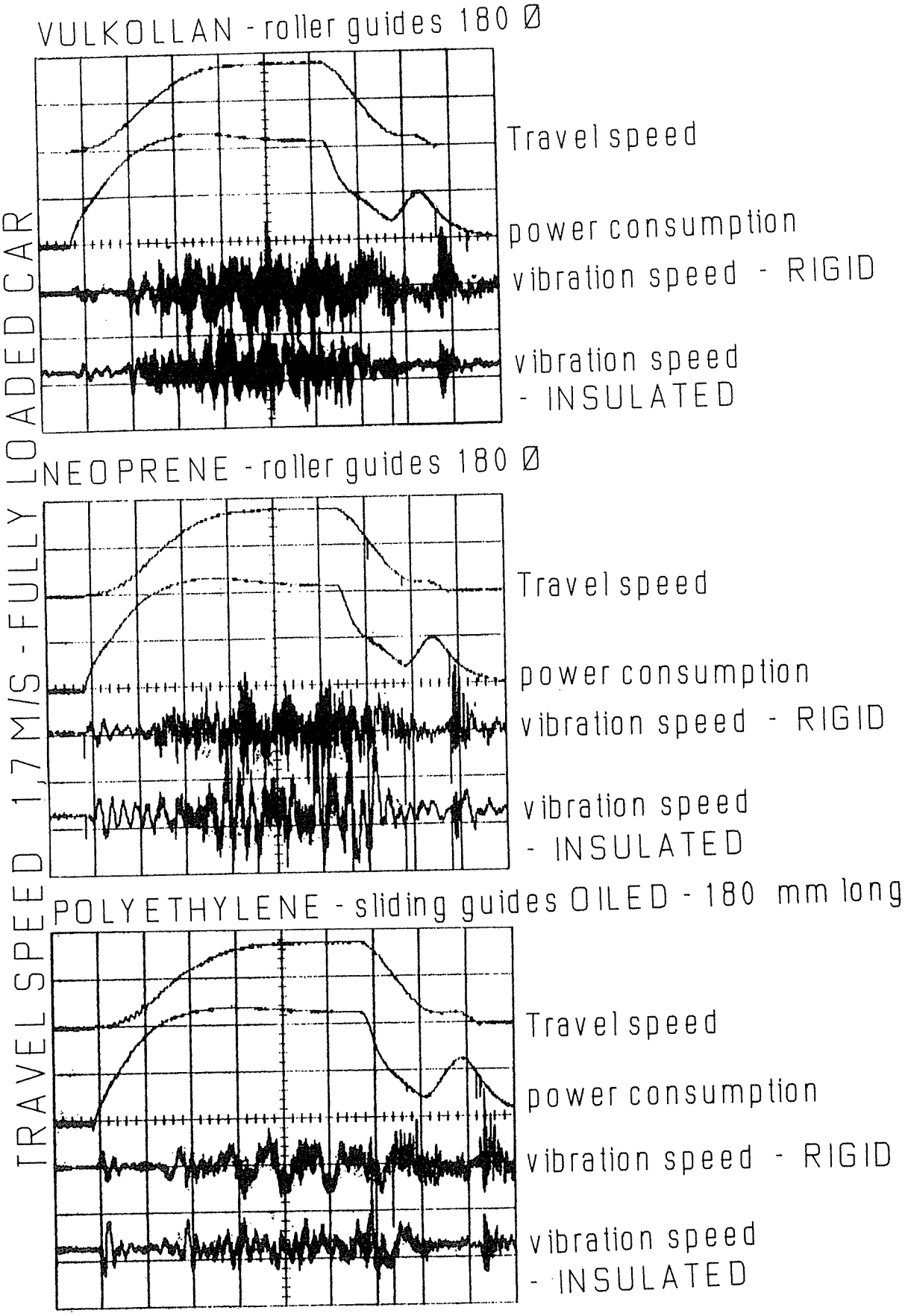
b) Special attention must certainly be paid to the car framework as the main supporting element of an elevator car . All of you involved with the mechanical side of elevator engineering will agree , that the design and manufacture of a car frame for a backpack elevator is more simple than for a centrally guided car . It is also easier to assemble and align the smaller number of steelwork components of a cantilevered car frame .

c) Not only do the car guide rails of a backpack unit demand special attention . The same applies to the actual car guides . They have to absorb entireley different forces as compared to a centrally guided elevator and require a different approch . As normal for elevators , there are sliding- and roller guides .

Purpose of this paper is to briefly analyse car guides for a backpack elevator with regard to power consumption and riding comfort.

a) Experimental elevator:
Backpack unit with drive unit on top, adjacent to the hoistway. 2:1 roped counterweight (double car weight plus payload). It travels only half the distance of the car. The traction sheave is driven from a planetary gearbox arranged behind an electric motor with belt transmission. The belt transmission allows changes of travel speeds by using different diameter belt pulleys. In the case of our experimental elevator, the counterweight is exactly double the weight of the empty car, i.e. with an empty car there is no actual hoisting work performed. It rises in direct propotion to any load added. As to the strains transmitted to the car guides and guide rails, a 350 kg load at the entrance sill corresponds to 600 kg evenly distributed.

All car enclosure mountings are rubber insulated.


VULKOLLAN - roller guides 180 Ø
Travel speed
power consumption
vibration speed - RIGID
vibration speed
- INSULATED
LOADED CAR
NEOPRENE - roller guides 180 Ø
Travel speed
power consumption
vibration speed - RIGID
vibration speed
- INSULATED
FULLY
1,7 M/S -
TRAVEL SPEED
POLYETHYLENE - sliding guides OILED - 180 mm long
Travel speed
power consumption
vibration speed - RIGID
vibration speed
- INSULATED

b) Measuring instruments for the experimental elevator:
Oscillograph with 4 simultaneous displays:

1) Measuring travel speed with tacho generator
2) Measuring current consumption with a 3 conductor transformer
3) Vibration speed in backpack direction, "rigid"
4) Vibration speed in backpack direction, "insulated"

The diagrams refer to different types of car guides and show the corresponding curves for travel speed and power consumption.

The graphs are selfexplanatory. In spite of higher travel speed the uppermost graph still indicates the lowest power consumption. In this case the loaded roller guide wheels were Vulkollan lined. Vulkollan is a polyurethane elastomer with a very high rebound resilience and a low compression set. For the hardness of the tyres a Shore A rating of about 93 has been selected.

The diagram below shows travel speed and power consumption with roller guide wheels such as normally employed for centrally guided elevators. Here the wheels are lined with Neoprene, a synthetic rubber material with a Shore hardness below 80. It is evident, that the travel speed already shows a slight drop, while the power consumption rises.

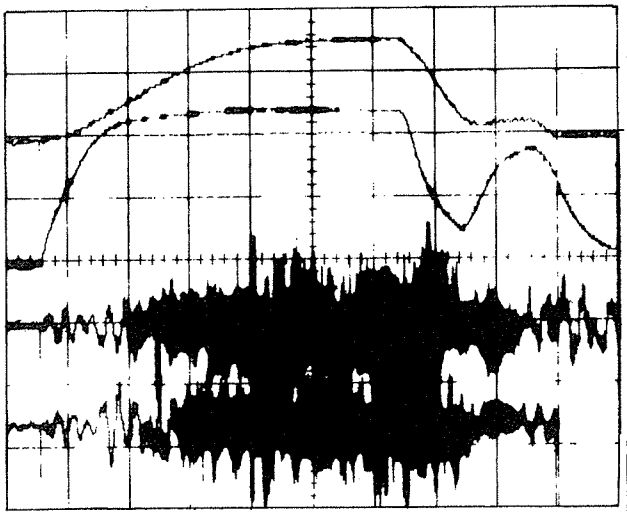
The buttom diagram shows an even further reduced travel speed with a noticable further increease in power consumption. Sliding guide shoes were used with low pressure Polyethylene, which to our knowledge has the lowest friction coefficient of all materials used with elevators.

If we include the reduced travel speed in our calculation, roller guides with Vulkollan lining require approximately 8% less electric power for the same hoisting performance than Polyethylene sliding guide shoes. The corresponding difference decreased to 5% when the same tests were repeated with a reduced speed of 0.9 m/s . This is only slightly more than the comparable differences with centrally guided elevators.

Let us now have a closer look at the riding characteristics:

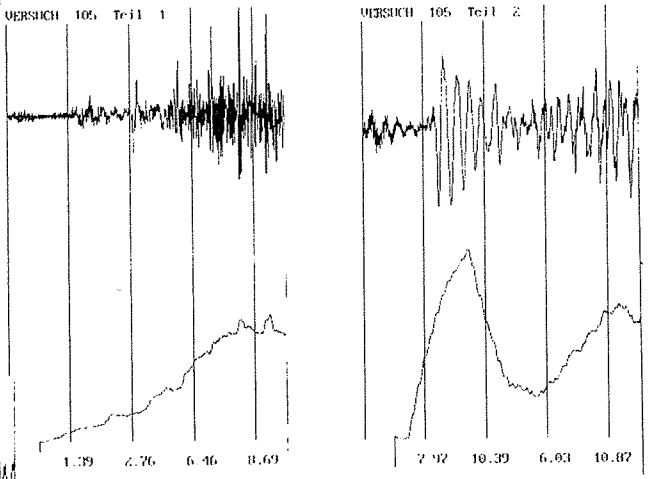
The two lower sets of curves represent the vibrations in backpack direction with the guides . The upper curve shows the vibration readings taken at the actual cantilevered car frame, while the lower curve indicates vibration data recorded at the rubber/metal insulated car enclose. It is obvious that reduced vibration occurs at the insulated car enclosed. The curve undulations reflect the distances between the guide rails fixings. Surely, there are less vibrations with sliding guide shoes, because to a certain extent the arael contact absorbs any rail imperfections.

From hereon let us disregard data related to travel speed and power consumption, but instead focus on data refering to vibrations, which influence the riding characteristics very much. In the course of our experiments we have recorded 126 sets of readings. We are pleased to present a selection to you.



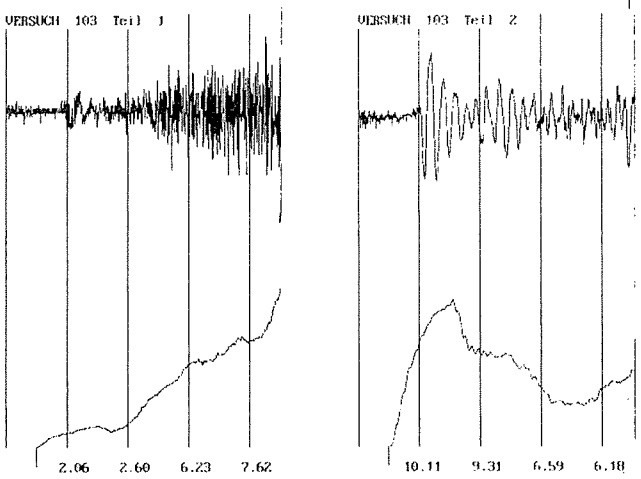
This diagram shows vibrations as recorded with ELSCO roller guides. Most of yuo will be familiar with this product, which is generally used for high performance elevators up to highest travel speeds. However, the heavily Neoprene lined wheels are not suitable for backpack type elevators.

Look also at the power consumption .



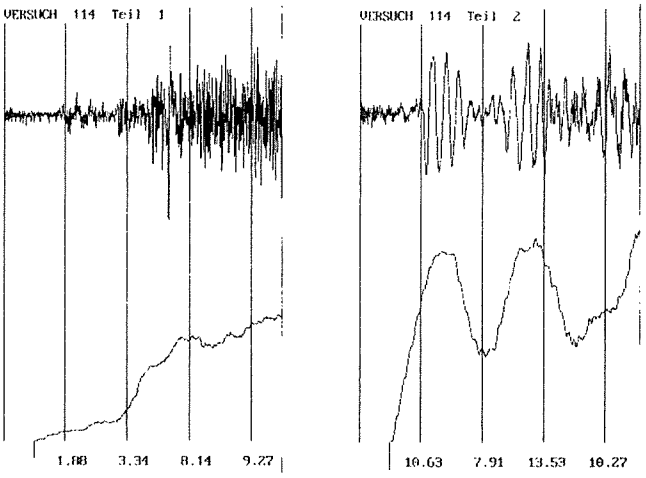
Versuch : 105

Individual roller
125 mm Diameter
Vulkollan Tyres
Teil 1 : rigid
Teil 2 : insulated



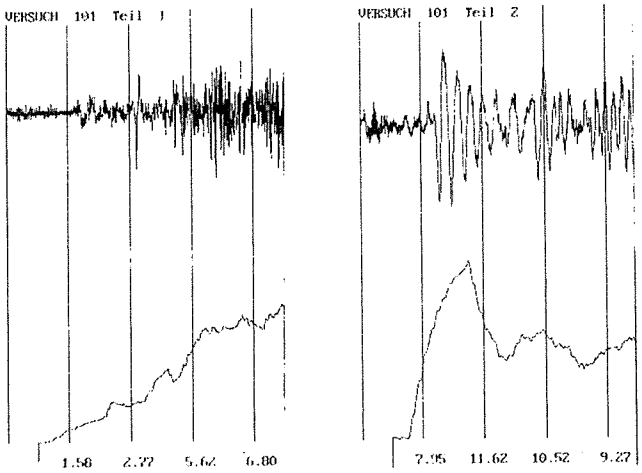
Versuch : 103

Individual roller
180 mm Diameter
Vulkollan Tyres
Teil 1 : rigid
Teil 2 : insulated



Versuch : 114

Individual roller
2 degree slant.
180 mm Diameter
Vulkollan Tyres
Teil 1 : rigid
Teil 2 : insulated

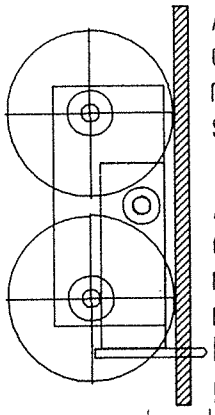


Versuch 101 : a tandem roller guide with 125 mm Vulkollan tyres
Teil 1 : rigid
Teil 2 : insulated

By far best results were obtained with tandem type roller guides using Vulkollan lined wheels of 180 mm diameter .

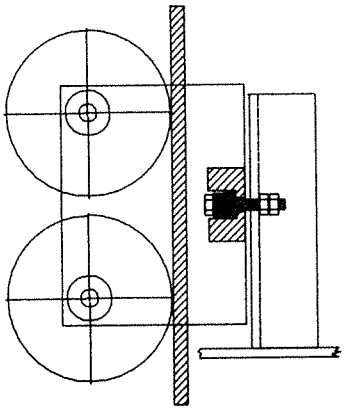
The following curves substantially undercut the vibration speeds of sliding guide shoes . However , the higher costs for roller guides must also be considered . Because only load carrying wheels are actually employed , roller guides for a backpack elevator are less expensive than for a centrally guided unit .

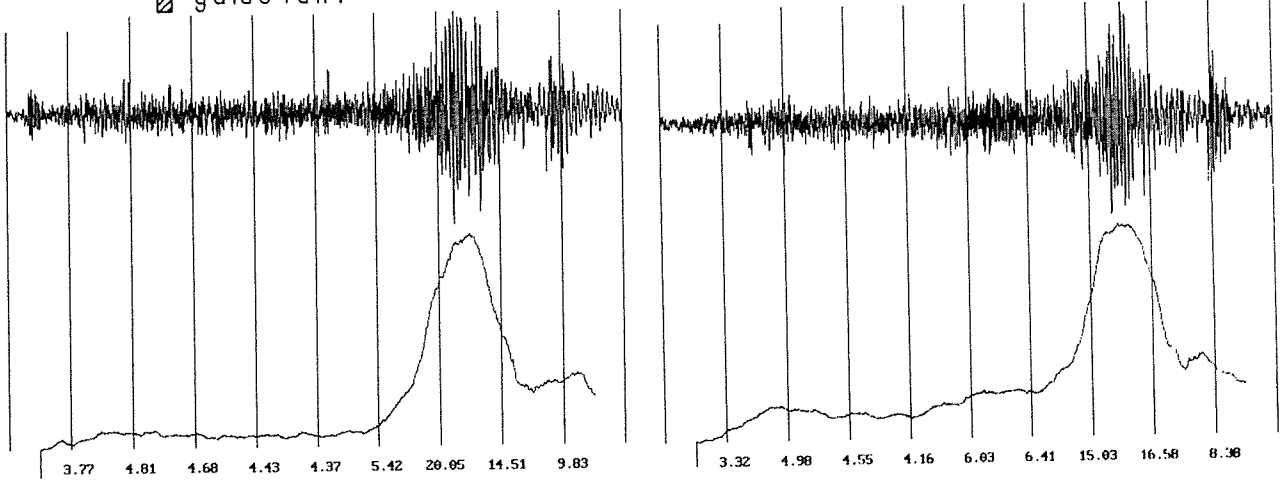
Two designs of supports can be employed :



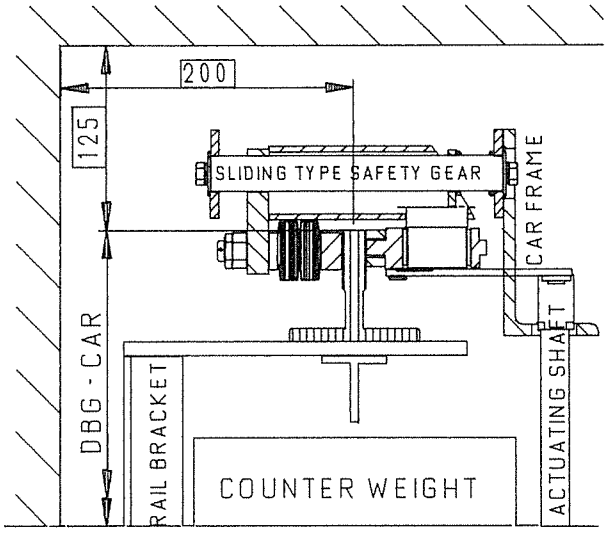
A pivoted tandem balance . Here the mechanic does the exact alignment of the pivot axis rectangular to the guide rails by adjusting the support at the car frame .

An idling tandem balance . The two load carrying backpack wheels parallel to the guide rails are guided by wheels running on the guide rail top . The tandem balance is supported by a ballsupport, which is placed centrally behind the guide rail .



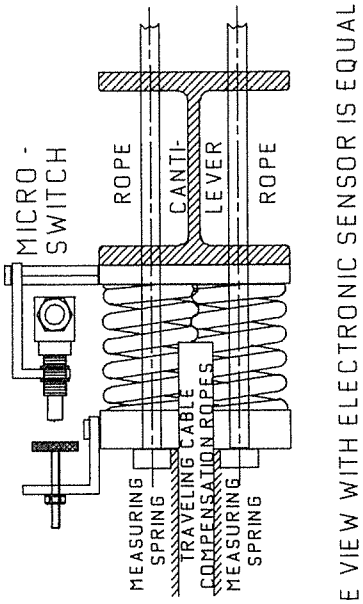


To render backpacks competitive with centrally guided elevators, those very components should be well adapted to the specific requirements:



a) Progressive type safety gears: This important safety device must neither be too deep nor too wide; particularily if used with outward facing car guide rails. For payloads plus car weight of up to 1700 kg , the clearances shown in our drawing are amply sufficient.

Because a safety gear may have to be removed for conversion or maintenance purposes, a suitable car frame design is needed, which allows for the restricted space towards the shaft wall.



SIDE VIEW WITH ELECTRONIC SENSOR IS EQUAL

b) With a backpack elevator, load weighing is relatively simple. All car ropes come together at one point at the extension bracket of the lower car framework. Load weighing with coil springs does not present a problem, because normally the entire car enclosure within the car framework is guided by rollers with very little friction. The rope anchor bracket independently carries the traveling cable and possibly, compensating ropes. While traveling, their changing weight is not weighed.

c) As mentioned, for excentric loads roller guides are definitely superior to sliding guides in limited power consumption. Special attention should be given to the design of the roller guide supports. The height of the roller guide assembly is restricted because the surroundings of the guide rails in the elevator pit is reduced by the special understructure of the cantilevered car framework. Because the area adjacent to the guide rails for supporting the roller guide is narrow, the load carrying rollers have to be exactly aligned parallel to the guide rails and thereafter must be firmly secured to a rigid frame stricture.

Biographical notes :

Gerhard A . Schlosser , Ing. HTL has been working on the mechanical side of elevator design since 1955 . As managing director he took over full responsibility for two companies manufacturing specialized elevator components in 1977 .