ELEVATORS FOR EXISTING BUILDINGS - PREFABRICATION AND PILOT SERIES FOR CONTINUED DEVELOPMENT

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ABSTRACT
At ELEVCON in Nice in 1986, the background as well as the start-up of the development work in Sweden for lifts suitable for existing multi-family residential buildings was presented. The project has continued under the direction of the Swedish Lift Group. The first pilot projects were followed by more prefabrication and delivery of series of pilot lifts. The experiences of the projects have now been used to change the codes and regulations for lifts and buildings in Sweden. Government programmes for rebuilding houses to make them suitable for elderly and disabled people have started in other countries. Standardization work will now be essential for further progress.

1 BACKGROUND

In 1983, the Swedish Government and Parliament set up the goal that everyone in Sweden - regardless of age or disability - should be able to live in a house with good accessibility. Later on, this objective was further strengthened by a programme for better housing conditions for elderly people. The contents of this programme was that, to a greater extent, elderly people should be able to live in ordinary housing estates - also when growing older and the mobility is impaired - instead of being confined to institutions. The same objective also applies to disabled people. The Government allotted special funds for development work concerning lifts in older multi-family residential buildings and, during a certain period of time, also government grants for the installation of lifts in older buildings. The total grants were 50 % of the lift installation costs approved. The rest of the costs could also be covered by favourable government loans at a low rate of interest.

2 OBJECTIVES OF THE LIFT GROUP

Formed by the Swedish Council for Building Research, the Lift Group consists of architects, engineers and representatives of different authorities, government agencies and organizations

concerned by installations of lifts. The Group documented, at an early stage, experiences and costs derived from installations of traditional lifts in older multi-family residential buildings. These analyses proved that the lift solutions, hitherto available, were not adapted to cope with the problems arising in older residential buildings. As a rule, the time of installation was very long, which made it practically impossible for the tenants to stay on in their homes during the installation, even if the lift installation took place outside the flats. The existing lifts required large areas and volumes outside the lift car in the lift well, as well as space for shaft pit, shaft top and machine room. All this contributed to making the lifts too space-requiring in relation to the utility area created by the lift itself. The installation costs were also very high. The total costs of installing a lift had not previously been known. Very often these costs had been included in the other construction costs arising from e.g. a large rebuilding. The Group also pointed out the large expenses for exacting construction jobs and evacuation of the tenants, as well as costs arising from delays between different occupational groups engaged.

The Lift Group set the following goals for lifts adapted to be fitted into older multi-family residential buildings:

- functional lifts with minimum dimensions required for stretcher (see Figure 1) and/or wheel-chair;
- space-saving lifts, i.e. effective outside the interior car;
- safe lifts, i.e. no scaling-down of safety requirements;
- quickly installable lifts, i.e. the installation will only require a few days' evacuation of the tenants; and finally
- reduction of the total costs, i.e. including construction and evacuation costs, to 50 % of the original sum.

Lift for stretcher transport

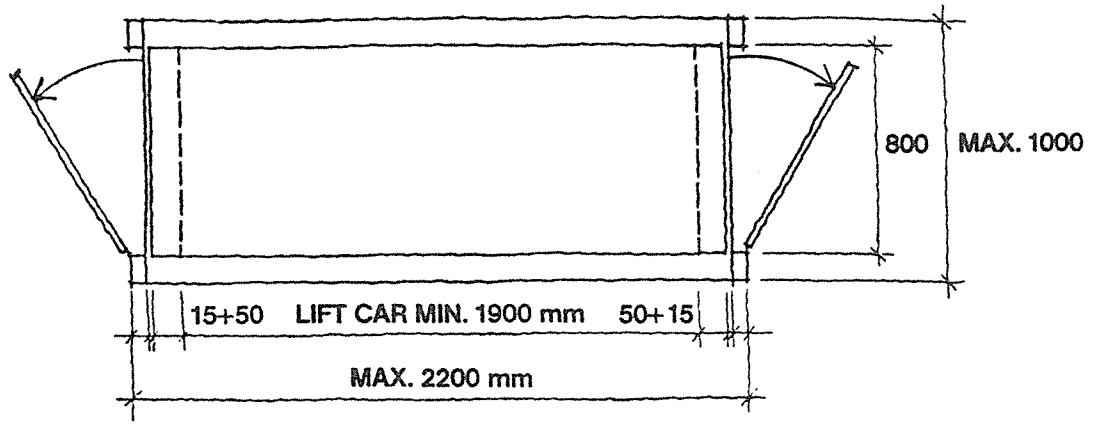

FIGURE 1: Lift for stretcher transport "slim lift"

3 DEMONSTRATION PROJECTS

We have earlier reported, i.a. in connection with the 1986 ELEVCON in Nice, that we have initiated a great number of different demonstration projects. The objective of the first projects was not that we should be able to arrive at solutions to all the different partial problems connected with installing lifts in older multi-family residential buildings. Fully ten projects have been carried through with different partial objectives, e.g. speedier installation of lifts, reduction of the exacting construction work, alternative safety arrangements, etc. These demonstration projects were carried out at several different places in Sweden by different lift makers and building contractors in co-operation with different municipal and private housing corporations. It should be emphasized that only through the engaged participation of all the parties concerned has it been possible to carry out these projects and attain valuable experience. In several projects tests could be carried out at the same time. These tests - related to the reduced dimensions obtained in stair-wells after the installation of lifts - concerned satisfactory evacuation roads from the point of view of fire-protection, possibilities of transporting sick people on stretchers and the use of the lifts by people sitting in wheelchairs(see Figure 2). These tests have been carried out in collaboration with representatives of e.g. different government agencies, standardisation bodies, trade unions and housing corporations.

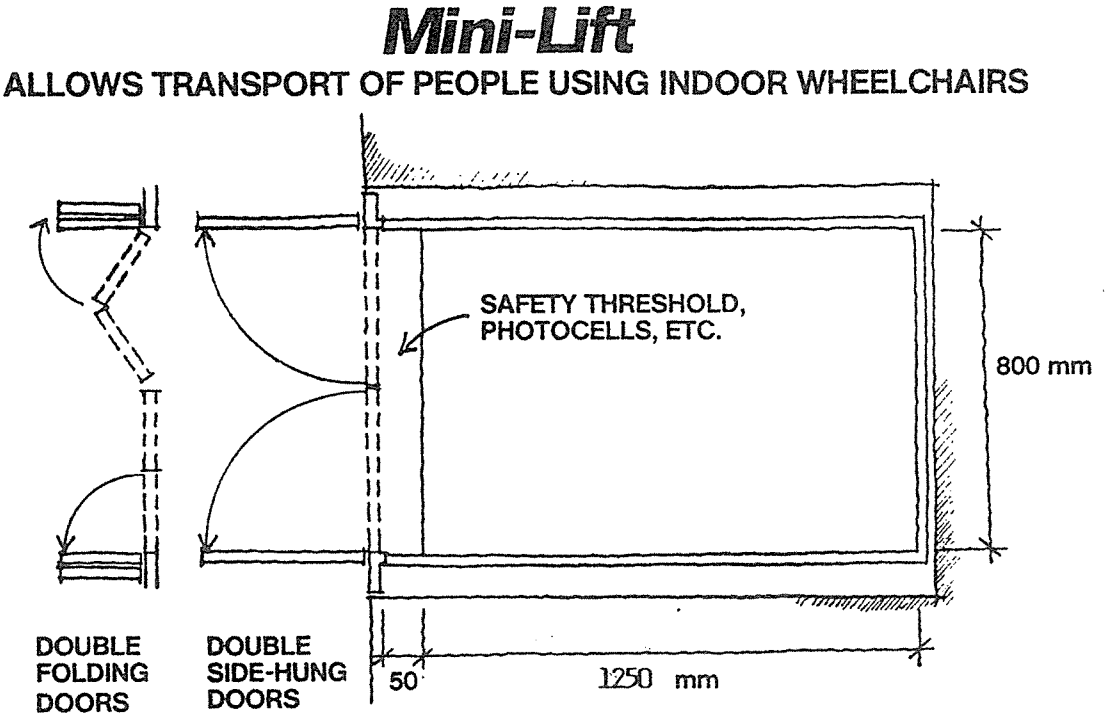

FIGURE 2: Lift for wheelchairs "mini-lift"

In connection with installations of lifts in stair-wells, different ways of manufacturing shaft walls have been tried out in

order to reduce the assembly time. The assembly of the shaft walls has, as a rule, been entrusted from the building contractors to the lift makers, resulting in improved tolerances and dimensional accuracy. At the same time, the lift makers have been able to plan the use of the inside of the shaft walls more effectively already from the beginning. Already at an early stage, the possibilities of reducing the time required for the installation and the costs by about 25 % were established.

4 PILOT SERIES INSTALLATIONS OF LIFTS

In order to further promote the development work in Sweden, possibilities of making a number of series installations, in addition to separate pilot projects, have been opened up through government grants. These pilot series have been carried out in somewhat different ways at different places throughout the country. It should be pointed out that considerable work has been spent in trying to make several property owners co-operate in joint purchases of lifts. Conditions may vary and viewpoints may also diverge as to the suitable design of the lift delivery. This work has, however, resulted in installations of series of lifts in five different places in Sweden as shown in Table 1.

Köping	30 lifts, 5 different housing corporations
Danderyd	37 lifts, Danderydsbostäder AB*
Stockholm/Kärrtorp	5 lifts, AB Svenska Bostäder* (installation of another 13 lifts in 1988)
Gothenburg	18 lifts, AB Familjebostäder*
Skåne	4-5 different corporations in different municipalities in Skåne have signed a general framework contract as to a future delivery of 25-50 lifts

* Municipal housing corporation

TABLE 1: Series installations of lifts

In Köping, several housing corporations have co-operated through the agency of the municipality of Köping. The municipality has taken care of the procurement and has concluded a general framework contract with the lift maker C.E. Söderlund Hiss AB. Being one of the lift makers that earlier made a demonstration installation in Köping, this company has delivered a lift with indirect-acting hydraulic drive and chain. Gradually, the company has been able to render its production more effective, so that an installation of one lift, including shaft walls, in a 3-storey residential building can be carried out by two persons in one week. The construction jobs have formed a separate part in these projects, since construction conditions have varied between the different buildings. From a first guaranteed delivery of 13 lifts, the series has been extended to about 30 lifts delivered up to now. The company has gradually developed its safety devices, using a shaft pit measuring only 10 cm and space requirements for the machinery so small that there is room enough for the machinery

under half a flight of stairs in the stair-well, and no space required above the lift well.

In Danderyd, the lifts have been delivered within the compass of a turn-key contract, the turn-key contractor being the building contractor ABV. Kone Hissar AB has been the lift supplier. The lifts have been of various types - a small number externally located, and the others located in the stair-well, most of them in the shape of so-called slim lifts. During the installation work, both the building contractor and the lift maker have developed their lift installation techniques as regards sawing of the stairs and relocation of the ramp of stairs, development and assembly of the lift well, and, finally, development of a small machine cabinet. Kone Hissar AB is now able to supply, as standard, a lift, the machine cabinet of which is no larger than a refrigerator, measuring 65 x 80 x 180 cm. A considerable pre-fabrication has been developed in this connection.

In Stockholm/Kärrtorp, NTD Hissar has developed their screw lift still further, as has been reported earlier, for continued installation in residential buildings owned by AB Svenska Bostäder. The first prototype led up to installation of another 4 lifts, included in a pilot series. The company has developed their driving system and also uses a computerized control panel, simplifying the floor levelling of the lift and facilitating the registration of different break-downs. The machinery is located on top of the car, and consequently, space is required only for an electric cabinet. In 1988 another 13 lifts are to be installed.

In Gothenburg, 10 lifts - in a procurement of 18 lifts - have as yet been installed for Familjebostäder AB. The lifts are so-called mini-lifts (see Figure 3) with room for a wheelchair. In this case, the transportation of stretchers must be done in the remaining stairs. These lifts are installed by Kone Hissar AB.

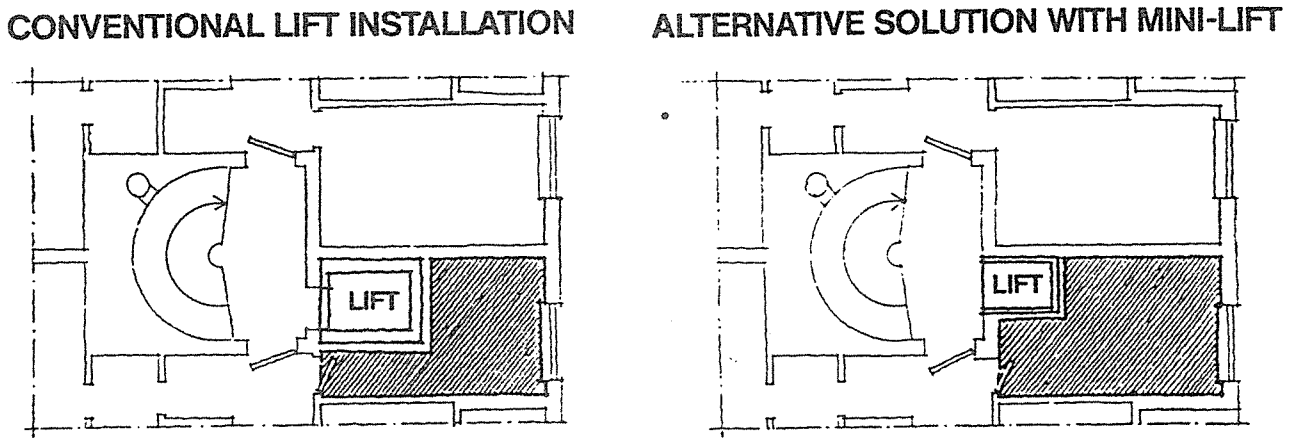

FIGURE 3: Installing a mini-lift is area-saving as compared to a conventional lift installation

For Skånehem - a joint organization of several municipal housing corporations in the province of Skåne in southern Sweden - a general framework contract has been concluded, in which Bauer Hissar AB undertakes, on specified conditions, to supply lifts in Skåne to the compass of 25-50 lifts during the years 1988-89. A procurement, in which 2 different prototypes were tested, formed the basis of this undertaking. The prototypes were tested by use of a microcomputerized program. The approved lift is of the indirect-acting hydraulic type, also using a small machine cabinet. The maintenance requirements have been considerably reduced, due to the fact that i.a. the bearings require less lubrication. The general framework provides possibilities of subordering lifts of different travel heights but with exactly the same design as to car, rated load, speed, etc.

5 FURTHER DEVELOPMENT OF NEW TECHNIQUES

New techniques for a further number of lifts have been developed. This applies e.g. to a lift from Inliftor AB in Uppsala (see Figure 4 a-b), using a fixed chain and the machinery on top of the car. The electric cabinet is placed inside the car, which has further reduced the space requirements outside the car.

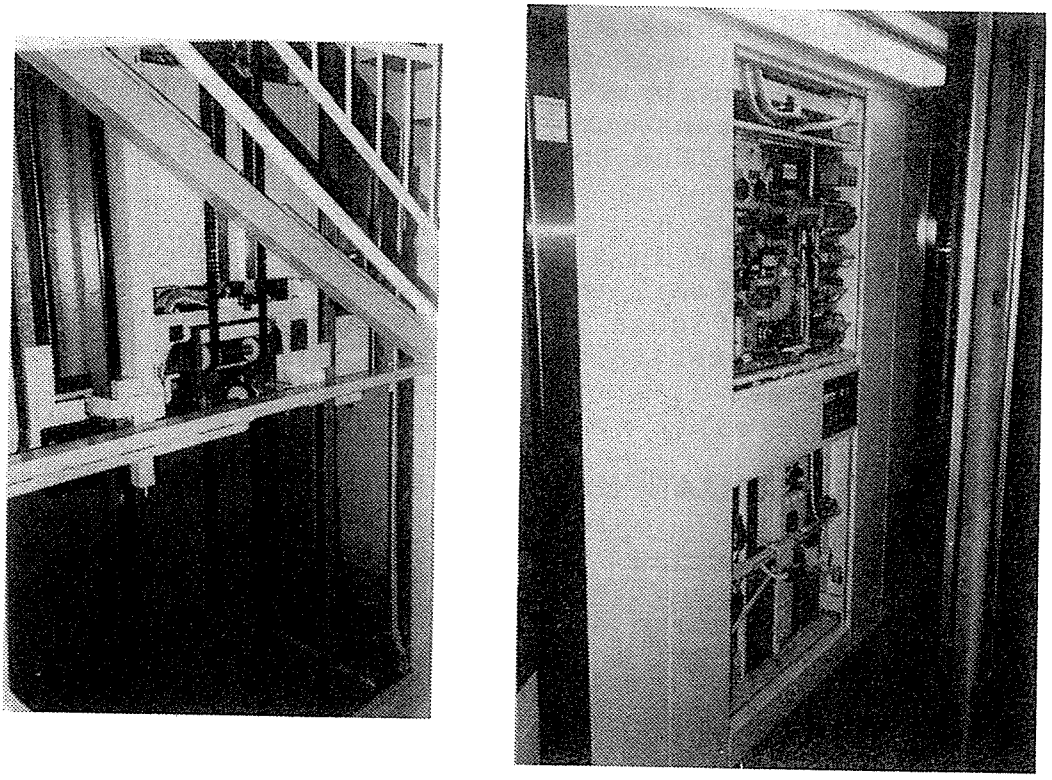

FIGURE 4: Inliftor AB*
a) The lift uses a fixed chain and machinery on top of the lift car
b) The electric cabinet is located inside the lift car

A lift, now being installed by the lift maker Liftin AB, has

advanced still further as far as prefabrication is concerned. This company was formed by the building contractor ABV and Kockums AB, a shipyard also manufacturing engineering products. In this case, the whole lift well for a 3-4-storey residential building is prefabricated. The lift is mounted inside the lift well and already tested at the factory. The whole lift well is then being lifted in through the roof of the building using large mobile cranes (see Figure 6). It has been possible to reduce the whole work procedure so that a complete installation, including the construction work, can be made in 2-3 days. The degree of prefabrication is, thus, very high in this case. Different driving systems are used, e.g. indirect-acting screw drive or indirect-acting hydraulic drive.

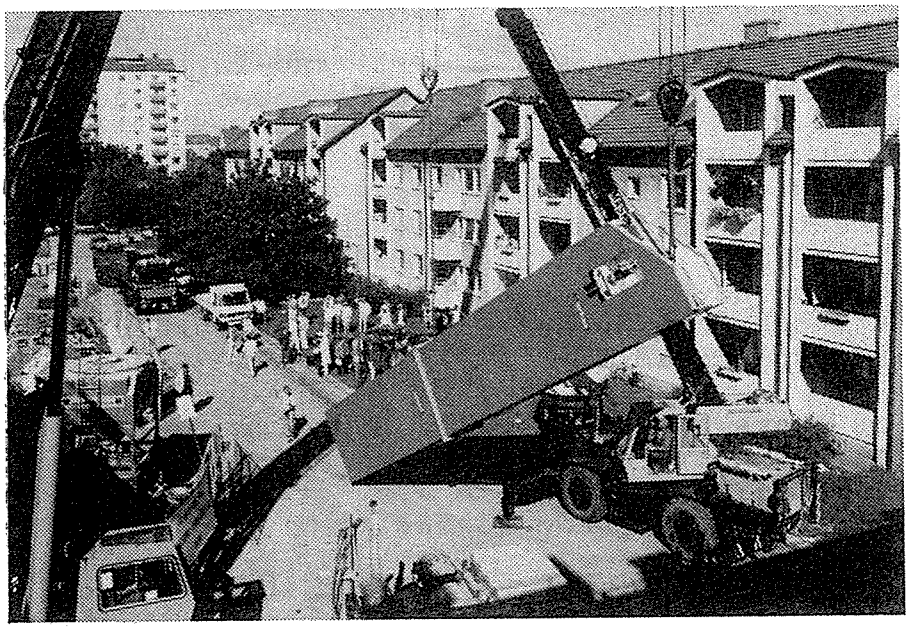

FIGURE 6: Liftin AB - A completely prefabricated lift well is being hoisted in by means of a mobile crane

Other companies that have developed lift products for existing older residential buildings are e.g. DEVE Hissar AB, Schindler AB and Thyssen AB.

6 EVALUATION

In connection with the installations, new safety devices have been used instead of escape spaces at the top and bottom of the lift well. The design of these devices have been tested under working conditions by authorities and trade-union organizations concerned. New principles have been used, e.g. the location of a mat on the remaining small shaft pit (10 cm), functioning in such a way that as soon as the mat is loaded and the lift is not at floor level, the lift car is blocked. Before being brought into operation again, the lift has to be reset by means of a

special switch in the machine room/machine cabinet. The use of these mats or hidden door contacts have been combined with automatic-acting blocking devices at the bottom of the car, impeding squeezing. At the top of the car a stop device must be activated before the lift can be driven from the car top for service purposes. After wishes had been expressed from trade-union organizations to supplement the safety arrangements with a manually mountable bar in the lower part of the pit space, this has recently been done. All these solutions are now being evaluated in order to be further improved from the point of view of safety. The lift regulations have been revised in accordance with the above-mentioned principles. These principles were described in a paper (Westling, 1986) presented at the 1986 ELEVCON in Nice.

Testings have been performed, both practically and by use of a CAD-model, regarding the minimum dimensions required for stretcher transportation in stair wells and in the lifts. Corresponding tests have also been performed as regards wheel-chairs.

Fire-fighting and evacuation tests have been performed in stair-wells in residential buildings, where the width of the stairs is below the standard. As has been mentioned above, the new driving techniques have also been submitted to tests, during which the lifts are continuously driven in accordance with a microcomputerized program.

The glazing of doors and shaft walls has also been tested. The use of glazing will give a brighter and more attractive im-pression to a lift installation in a stair-well. In Danderyd for instance, glazing has been tested to a large extent (see Figure 7 a-c).

A special prototype, a so-called low-height hoist, has been developed to be used when transporting a wheelchair over minor level differences - up to half a flight of stairs. Such a proto-type has been tested by Bostads AB Mimer in Västerås. The com-pany Motala Portautomatik AB is the supplier of this hoist. In this connection, a special ramp of stairs has also been devel-oped to be used for these small heights. This ramp is easily transformable into a movable platform for a wheel-chair. This ramp has been developed by SIDECO AB, Sigtuna.

7 CONTINUED WORK

Continued development work is planned for external lifts with the use of a very high degree of prefabrication, and for stairs fabricated in other materials, e.g. steel. The elaboration of Swedish Standard for lift installations in older residential buildings is also in progress. It can also be pointed out in this context that similar development groups working with housing conditions for elderly people and lift installations have been formed in Norway, Denmark, Finland and the Netherlands.

The fulfilment of some of the above-mentioned objectives have exceeded our expectations. This applies to the reduced space requirements outside the lifts and the shortened time of installation. The costs have been cut by one third. Another urgent task is to promote package deliveries of lifts with far-reaching joint activities as far as the construction work and lift installation are concerned. The guiding principles as to contacts to be taken with the residents, information to be given about the work etc. need to be further worked out, especially in cases where the tenants stay on in their flats during the whole installation. Finally, the administration of various authorizations to be obtained from the authorities has to be simplified. At present, a large number of documents are needed for a lift installation. For owners of small private residential buildings, unaccustumed to filling in forms, this is a demanding task which, in lack of an organization of their own, requires expensive expert advice. Continued grants to the house-owners making lift installations, designed in accordance with simple rules, are urgent. According to estimations made, society may save considerable amounts if elderly and disabled people can stay on living in their normal flats with the aid of domestic help instead of having to be confined to institutions. Cost savings amounting to SEK 100,000 a year have been noted, which, from the point of view of the national economy, makes a lift installation refunded in a few years at the same time as the human aspects for elderly and disabled people always are the most important reference points for lift installations.

8 REFERENCES

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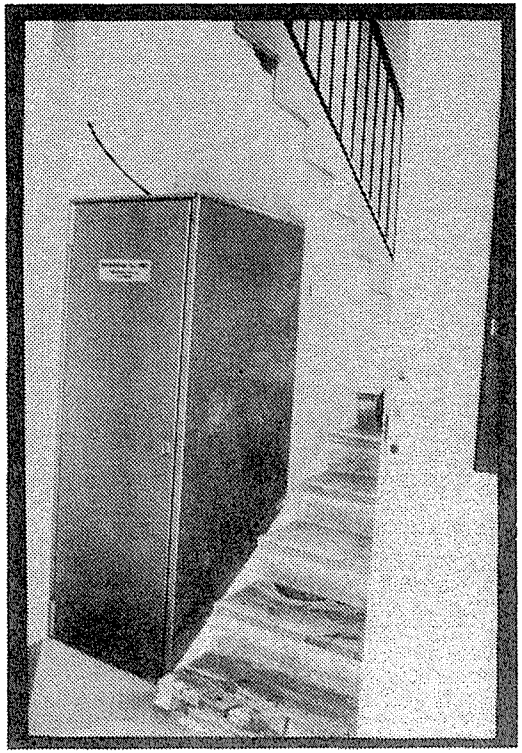
* Figure 4 a-b by courtesy of William B. Sturgeon, Elevator World



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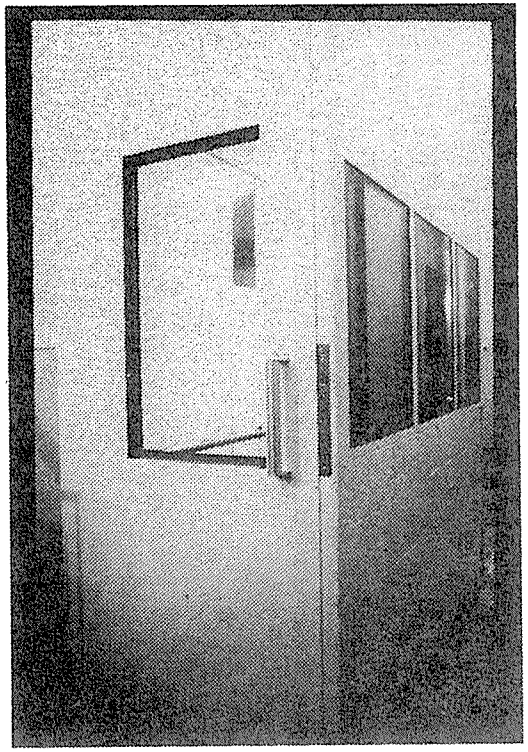

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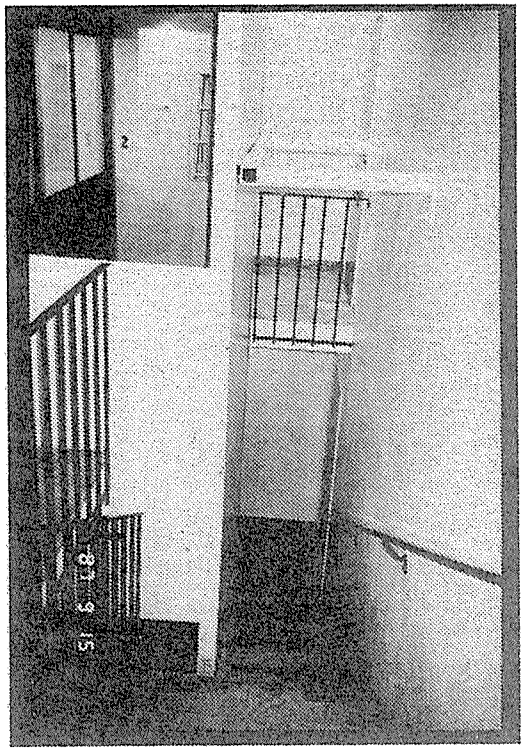

c)

FIGURE 7: a) Prefabricated machine room b) & c) Glass in shaft walls and shaft doors creates a brighter impression