# lift Industry News

A UK-BASED MAGAZINE WITH A GLOBAL OUTLOOK FOR THE LIFT AND ESCALATOR INDUSTRY

NEWS » VIEWS » PEOPLE » SAFETY » TRAINING » STUDY


## Can we help...

Are you employed in the Lift industry?

Have you, or someone you know, had a works related accident?

Did you know there is financial help available?

# The UK Lift Industry Charity

## Run by Lift People for Lift People

**The UK Lift Industry Charity Mission...** The relief of financial hardship and provision of appropriate support where required to industry colleagues and their families who have been injured whilst working or employed within the industry.

The Charity has made numerous donations to individuals and the families of individuals who have been injured or sadly killed, whilst working in the Industry. We are continually looking for opportunities where we can assist.

Can we help you, can you help us, would you like to join in the next **2023 Cycling Challenge** just email

reiss.stygal@aa-electrical.com
**www.liftindustrycharity.co.uk**

**Thank you** to all The Lift Industry Karting Challenge sponsors, donors & participants

Charity Registration No. 1119434

lift Industry News

UK-BASED MAGAZINE WITH A GLOBAL OUTLOOK FOR THE LIFT AND ESCALATOR INDUSTRY

**Editor:** Patricia Reading

**Content Advisor:** Dave Cooper

**Copy Editor/Writer:** LJ Stocks

**Graphic Design:** Sonia Hall

**Social Media:** Emma Mackley

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*hello@liftindustrynews.com*

# lift Industry News

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CONTACT » Patricia Reading

www.liftindustrynews.com/contact

Email: hello@liftindustrynews.com

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lift Industry News

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## THIS QUARTER





BRAKE FAILURES ON LIFTS

### THE INTERVIEW

Stannah has been in the lift industry for 155 years. Our interview is with a fifth generation member of the family, Alastair Stannah, to get his take on the past, the present and the future of the company and how safety is ingrained in their business.

### THE KNOWLEDGE BANK

Our experts review Brake Failures on Lifts, Failure of the Braking System on an Escalator, LOLER in Care Homes and a Brief History of Lift Safety.

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# ADAM SCOTT OVERVIEW

## Welcome to the first edition of Lift Industry News

Our guest editor for this issue is Adam Scott, Technical Director for Vertical Transportation at engineering consultancy, Sweco, member of the BSI MHE4 standards committee, and Chair of the CIBSE Lifts Group.

**I'm delighted to have been asked to be the first guest editor in my capacity as Chair of the CIBSE Lifts Group.**

This magazine is a great initiative. As a UK-based magazine with a global outlook, its purpose is to raise the profile of the UK lift sector – its industry, education, research and charities. With lots of changes in the lift industry, it's invaluable to have the ability to push news, knowledge, information and opinion out into the market, as well as giving another avenue for LEIA and CIBSE Lifts Group to disseminate news.

This is a very important time for the lift industry, we're over 30 years into a global urbanisation trend that is only going to continue to grow. Buildings are becoming taller and larger in response, even if those in local markets such as London are not yet tall in the global sense, creating plenty of demand and challenges ahead.

Energy and sustainability is a great focus for us all at the moment, and the part that lifts can play in overall energy efficiency is becoming more and more apparent. As engineers we're seeing a greater need for more detailed energy forecasting for lift systems, which is creating challenges in getting access to the right data and making sure our modelling estimates are as accurate as possible.

There's a very interesting interview with lift industry veteran, Gina Barney on page 77, who talks about her work on classifying the energy efficiency of lifts and escalators and revising the associated standard.

There's a lot of work to be done around the Building Safety Act, and with a theme of safety for this first issue, you'll find an interview with Alastair Stannah on page 30 who talks about ingraining safety as a top priority, as well as the additional responsibilities placed on lift companies as a result of the tragedy at Grenfell Tower.

Our CIBSE Lifts Group update can be found on page 82. At our CIBSE Lifts Group Meeting in June we looked at the standards affecting evacuation lifts and how we can provide safe and dignified egress in event of an emergency. There is evidently work needed to clarify elements of the guidance documents, and we as an industry need to respond appropriately and accurately with the right equipment. Together with LEIA, we've been lobbying the drafting committee to tighten up the language and improve the guidance.

Training and resource is another of my top trends. We're aware that there is a significant lack of resource in a growing market, and I hope that this magazine serves to share and increase knowledge of the sector, encouraging new talent and new companies. Our Elevator Pitch, on page 88, talks to Matt Appleby, an apprentice at Peters Research, and it's great to hear about his first steps into the industry. We also hear from the University of Northampton on page 16, looking at the academic qualifications specific to the lift industry.

There's plenty to be excited about in our sector, with opportunities to encourage the next generation into the industry. I do hope you enjoy this issue, and are encouraged by the huge amount of work going on to drive the lift industry forward – or upwards, maybe!

"This magazine is a great initiative"

# LIFTEX 2022

VISIT US AT STAND B30
BETWEEN 12TH - 13TH
OCTOBER 2022


## 2022, AN IMPORTANT YEAR FOR LESTER CONTROLS NEW PRODUCTS DEBUTING AT LIFTEX

2022 is destined to be an important year for Lester Controls, starting off with a move to a new and enlarged premises to accommodate increased production and customer training facilities. The move forms part of our ongoing approach towards pre-order and post-delivery customer support, which has been strengthened over the past two years.

Many of our customers will be aware that we have been working with renowned lift technology experts, Peters Research, to develop and produce a hall call solution for our latest range of ALMEGA controllers which is now approaching the time when we can publicly display a working example. This will occur at Liftex 2022 in October, along with other new product launches being revealed on the Lester Controls stand B30.


The new advanced universal lift dispatcher called Elevate Dispatch, designed by Peters Research, are also the developers of industry leading lift traffic and grouping analysis software, and are known worldwide for their elevate products. The software and interface to the ALMEGA II have been under test for the past 18 months at our Lutterworth premises and most recently in a fully functional commercial building.

**We will also be showing our latest range of control solutions, along with the CEDES iDiscovery.**

Head Office
59 Imperial Way,
Croydon, Surrey, CR0 4RR
T: 020 8288 0668

Midlands Office
Units 1-4 Wycliffe Industrial Park,
Leicester Road, Lutterworth,
Leicestershire, LE17 4HG
T: 01455 204980

Glasgow Office
4 Lonmay Place, Panorama Business Park, Glasgow, G33 4ER
T: 0141 771 6171

www.lestercontrols.co.uk

# Lift Industry News CALENDAR

July 19 - 21 Tues to Thurs

## Expo Elevador 2022
July 19-21
SÃO PAULO, BRAZIL

September 21 - 22 Weds to Thurs

## E2 Forum
September 21-22
FRANKFURT, GERMANY

October 12 - 13 Weds to Thurs

## LIFTEX 2022
October 12-13
LONDON

July 21 - 23 Thurs to Sat

## Lift City Expo Egypt
July 21-23
CAIRO, EGYPT

September 21 - 22 Weds to Thurs

## Lift & Escalator Technologies Symposium
September 21-22
NORTHAMPTON, UK & ONLINE

October 18 - 20 Tues to Thurs

## Global Lift & Escalator Africa
October 18-20
JOHANNESBURG, SOUTH AFRICA

September 06 - 08 Tues to Thurs

## International Elevator & Escalator Expo
September 6-8
MUMBAI, INDIA

September 26 - 28 Mon to Weds

## The Elevator Show
September 26-28
DUBAI, UAE

October 19 - 21 Weds to Fri

## Lift Expo Italia
October 19-21
MILAN, ITALY

September 15 - 17 Thurs to Sat

## Inelex
September 15-17
IZMIR, TURKEY

October 05 - 06 Weds to Thurs

## EURO-LIFT
October 5-6
KIELCE, POLAND

November 03 - 05 Thurs to Sat

## Global Lift & Escalator Expo
November 3-5
DHAKA, BANGLADESH

# 2022/2023

07 - 08 Mon to Tues November

## SEELIFT Network (South-East Europe Lift Network)

November 7-8

ZAGREB, CROATIA

09 - 12 Thurs to Sun March

## Asansor Istanbul

March 9-12

ISTANBUL, TURKEY

29 Tues November

## CIBSE Lifts Group Annual Seminar

November 29

LONDON, UK

23 - 25 Tues to Thurs May

## ExpoElevador

May 23 - 25, 2023

SÃO PAULO, BRAZIL

01 - 03 Thurs to Sat December

## International Sourcing Exposition for Elevators and Escalators

December 1-3

MUMBAI, INDIA

20 - 22 Tues to Thurs June

## Elevcon

June 20-22, 2023

PRAGUE, CZECH REPUBLIC

12 - 13 Mon to Tues December

## International Elevator & Escalator Symposium

December 12-13

BARCELONA, SPAIN

17 - 20 Tues to Fri October

## Interlift

17- 20 October, 2023

AUGSBURG, GERMANY

## LIFT & ESCALATOR TECHNOLOGIES SYMPOSIUM

The 13th Symposium will take place on 21 - 22 September 2022 at the Hilton Hotel, Northampton, UK. It will also be online. It brings together experts from the field of vertical transportation, offering opportunities for speakers to present peer reviewed papers on the subject of their research. Speakers include industry experts, academics and post graduate students. The 28 exciting and varied abstracts for this year's Symposium are listed on page 35.

*https://www.liftsymposium.org*

## LIFTEX

LIFTEX is the unmissable showcase for the lift, escalator, manufacturing and specification industries. Run by the industry for the industry it features over 100 UK & international exhibitors showcasing the latest products and services. Don't miss the first opportunity to meet face-to-face, see key new products and services first-hand and in person post lockdown and Brexit. The exhibition is brought to you by LEIA (Lift and Escalator Industry Association), in consultation with an international network of authoritative trade advisory bodies.

*www.liftexshow.com*

# LIFTEX IS BACK & BIGGER THAN EVER

**Now in its 34th year, LIFTEX 2022 returns to London's ExCeL this October (12 – 13th) and promises to be the biggest event to date.**

LIFTEX is the UK's only dedicated exhibition for the lift, escalator and access industry. The last event, held in 2019, smashed all records and this year's show looks set to continue the trend.

"LIFTEX only takes place once every three years, but we weren't sure if it would take place at all this time after the uncertainty of the past few years," Show Director, Oliver Greening, explains. "We've moved the dates from spring to autumn because of the pandemic. However, we have been delighted by the response from the industry. Demand for stands has been strong and we've already extended the floorplan to accommodate this. We are now sold out and have a waiting list for additional space. During these uncertain times, it's so encouraging to see the appetite from the industry to get together in person once again."

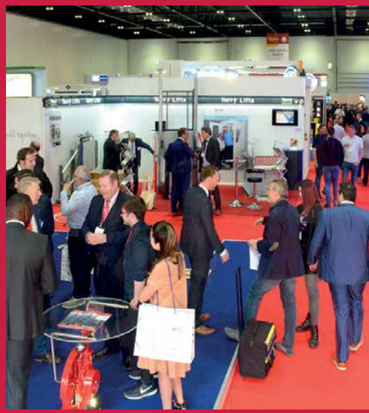
## Who will you meet?

"We've got a strong exhibitor line-up this year, with over 100 companies from the UK and world-wide including Canada, Croatia, France, Germany, Italy, Poland, Spain, Sweden, Switzerland and the USA. We're also welcoming new exhibitors this year such as Otis, Schindler and TKE. Visitors will find a breadth of industry representation including contractors, service companies, component suppliers and organisations from support services. This combined means that we're looking at the biggest LIFTEX yet."

## Free seminars & the latest guidance on buildings safety

Organised by LEIA, a popular element of the event is always the free seminar programme. Running alongside the exhibition across both days it brings together industry experts to discuss the latest hot topics. As we went to print the seminar programme was still being finalised.

"Seminars will cover key issues like modernisation, evacuation and safety, as well as the latest news on standards and regulations of course," according to Greening. "However, the biggest talking point will be to be the Buildings Safety Act and its implications for the industry. We'll be looking at it from the industry perspective, but also what it means for specifiers and building owners in terms of obligations and responsibilities. These are undoubtedly the biggest improvements in buildings safety in nearly 40 years, and LEIA will be sharing its guidance. There will also be opportunities to talk to the LEIA team throughout the show about this."



## PLANNING YOUR VISIT

With so much to see, how can you make the most of a visit to LIFTEX?

"Plan in advance to visit all stands with an open mind," advises Liam Dowdall, Operations Manager at Wittur, who return to LIFTEX after a short break this year. "Benefit from the seminars and hospitality and take the time to catch up and share experiences with other exhibitors and stakeholders and celebrate the reunion."

Phillip Rudd, Director, at Jackson Lift Group echoes this, "Look at the exhibitor list before you arrive, so that you can spend time visiting the stands that are most important to you. It is a large exhibition, and you could be in danger of getting way-laid rather than seeing the people you want." Jackson Lift Group has exhibited at every LIFTEX since its inception. His biggest piece of advice, however? "Wear comfortable shoes!"

To register for free visit *www.liftexshow.com*


interlift

1972 - 2022
50
years together
elevatori

# INTERLIFT 2022 REPORT

**Dedicated to the world of vertical transport, Interlift 2022 was held from the 26th to 29th April in Augsburg, Germany. Bringing the international lift family together for the first time in over two and a half years, the event saw 11,800 experts from 87 countries attend to discover innovations from 350 industry exhibitors.**

## OPENING THE FORUM WITH A LOOK AT SAFETY STANDARDS

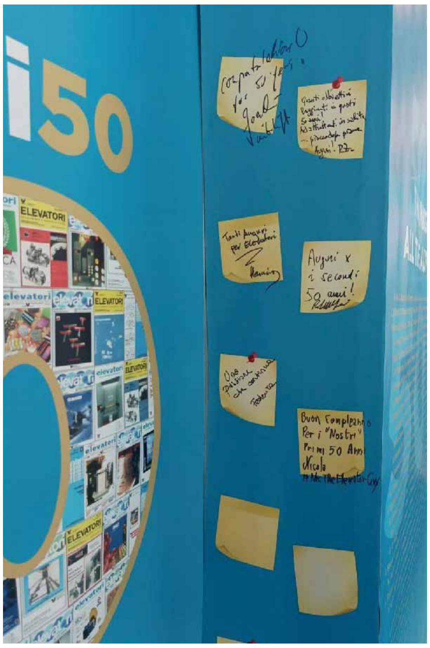
International elevator magazine, Elevatori were there, celebrating their 50th birthday. They had the pleasure of opening the VFA (Verband Für Aufzugs-Technik) Forum with Luca Borgonovo (Director for Business Development and Codes, SMI Italia) delivering the first speech of the day. Luca spoke about the standards regulating the modification of existing escalators and moving walkways and the huge opportunity for elevator companies to modernise them.

Nearly 50% of the 136,500 escalators and moving walks in use today in the European Union (EU) and the European Free Trade Association (EFTA) were installed over 20 years ago. Luca highlighted the lack of specific CEN standards for modifications to existing escalators and moving walks, and the potential hazards of the lack of regulations. He explained the reality of existing escalator modifications in Italy and looked at the opportunities that modernisation represents for elevator companies.

**Picture credits:**

Elevatori Magazine

Afag Messen und Ausstellungen GmbH

Luca suggested that an Italian standard – 'Alterations to existing escalators and moving walks' (UNI 10411-15:2018 standard) could be a best practice model for Europe and the escalator industry.

Other renowned experts provided insights into developments in European and international regulations, along with country-specific elevator market reports and product innovations. Topics covered included safety in the workplace and the increasing digitalisation processes, as well as the importance and practicalities of recruiting skilled workers and the ongoing training of them, which is increasingly vital across Europe.

To read a full report of Luca's speech and other news from Interlift 2022 please go to the Elevatori website ***www.elevatorimagazine.com***

## CELEBRATING WITH ELEVATORI MAGAZINE

Elevatori Magazine also premiered their book, '50 Years Together' at Interlift, to celebrate their milestone birthday. The book takes a journey along the history of the global elevator industry, through the magazine's issues, published over half a century. It also profiles Guiseppe Volpe, Elevatori's founder, who founded IGV, a small lift company, in 1966, and went on to develop the magazine six years later, in 1972.

## LIFT MATCH WELCOMES VIRTUAL VISITORS

For those unable to attend in person, Interlift provided 'Lift Match', taking visitors on a virtual tour of the trade fair. Around 100 participants were able to follow product presentations without having to travel to Germany.

## A POSITIVE OUTLOOK FOR THE INDUSTRY

A survey of visitors, taken by Gelszus Trade Fair Market Research showed an optimism about the future development of the elevator industry, with 67% expecting a strong or slightly increasing development in the next few years. This demonstrated a rise of 5% on 2019's survey. The survey revealed that 24% of visitors assume that economic development will remain constant.

Achim Hütter, President of VFA Interlift e.V. said of the event, "Luck is with the brave! We are indeed very happy that we have stuck to the decision to hold this Interlift 2022. Far more visitors than we had hoped for, top class discussions and good business. I think everyone's expectations have been clearly exceeded. It is hard to imagine a better starting situation for the upcoming Interlift."

Interlift is scheduled for 17th to 20th October 2023. With around 100 exhibitors already registered, it promises to be an exciting event. Find out more and register to attend – ***www.interlift.de/en/***

# GETTING QUALIFIED IN LIFT ENGINEERING WITH THE UNIVERSITY OF NORTHAMPTON

**With a growing need for more qualified vertical transportation experts, it's helpful to know where to steer any young (or even not so young) interest. The University of Northampton has a range of training and qualifications on offer, taught through distance learning, aimed at a specialist engineering education linked with the needs of the lift industry.**

Developed in partnership with LEIA, the provision includes:

- University Certificate in Lift and Escalator Technology
- Higher National Certificate (HNC) in Lift and Escalator Technology
- Higher National Diploma (HND) in Lift and Escalator Technology
- Masters (MSc) Lift Engineering
- Postgraduate Research (PGR) programme

This broad offering provides a range of courses to appeal to those at any stage – from school leavers to those wanting to switch career paths. The Certificate, HNC and HND awards provide the background and educational underpinning for the lift engineering technician career path. They have a modular structure covering the fundamentals of engineering including mechanical, electrical, electronic and hydraulic engineering, and have been developed to integrate three key elements: practice, learning and research.

Throughout the course, students look at real life examples from the lift industry to give a realistic view of the work and ensure the course stays relevant. Contract management and business are also covered as topics, and students undertake a work-based project, focusing on an area of their choice. Once completed, students can explore the MSc and PGR research degree programme, and are also able to pursue a general undergraduate engineering degree course (BSc Hons).

These lift-specific qualifications are a great addition to the industry, training up the next generation of experts in a sector that is quickly expanding. In the next issue we'll look in more detail at some of the courses and qualifications. You can find out more by visiting ***www.northampton.ac.uk*** and searching for the course you're interested in.

# LIFT ENGINEERING @ NORTHAMPTON

UON University of Northampton

## Academic qualifications:

- University Certificate in Lift and Escalator Technology
- Higher National Certificate (HNC) in Lift and Escalator Technology
- Higher National Diploma (HND) in Lift and Escalator Technology
- Masters (MSc) Lift Engineering

Engineering Council accredited degree

This degree has been accredited by the Institution of Mechanical Engineers under licence from the UK regulator, the Engineering Council. Accreditation is a mark of assurance that the degree meets the standards set by the Engineering Council in the UK Standard for Professional Engineering Competence (UK-SPEC)

## Postgraduate Research (PGR) programme:

undertake research degrees for the award of MPhil (Masters by research) and PhD (Doctorate)

- Systems engineering of lifts and escalators
- Ride quality, dynamics and vibration
- Intelligent fault detection and maintenance
- Control system
- Computer modelling, lift traffic analysis and simulation

TRANSPORTATION SYSTEMS IN BUILDINGS

A peer-reveiwed Open Access Journal.
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CIBSE Lifts Group | UON University of Northampton | Lift and Escalator Industry Association LEIA

CONTACT »

Email: sarah.field2@northampton.ac.uk
Email: enquiries@leia.co.uk

# LEIA TRAINING UPDATE


## Are apprenticeships the answer to the skills shortage?

**The new industry apprenticeship standards for our industry have brought traditional training into the modern era. This offers employers flexible training (and what's more, it has Government-backed funding).**

The employer-led training means greater flexibility and the opportunity to tailor the training to organisational needs where the gaps lie. But perhaps most crucially, an individual training plan to suit the needs of each apprentice.

Since the introduction of the Apprenticeship Levy in April 2017, funding has been available for both levy-paying organisations and smaller businesses (non-levy paying) looking to set up a scheme. The Government has backed the Lift Apprenticeship Scheme under Band 24 funding, which means there is a budget of £21,000 available for training and final end point assessment.

How this works is that employers in England who pay into the Apprenticeship Levy can draw down the funds to match the costs of the training programme up to £21,000.

**Smaller employers who do not pay "levy" are required to contribute 5% of the funded training costs circa £1050 for a £21,000 programme.**

For those employing fewer than 50 staff, the Government will pay 100% of the apprenticeship training costs up to the funding band maximum for apprentices aged:

- 16 to 18 or
- 19 to 24 with an education, health and care plan provided by their local authority or has been in the care of their local authority

***https://www.apprenticeships.gov.uk/employers/funding-an-apprenticeship#***

In 2020 LEIA launched its Lift Careers website which aims to promote apprenticeships in the industry. It links employers with potential apprentices showcasing the diverse range of opportunities. A two-year campaign has linked hundreds of new recruits with businesses running apprenticeship schemes. Find out more at ***https://liftcareers.co.uk/***

# Lift Training Lab

Bridge House, Station Approach, Great Missenden, Bucks, HP16 9AZ, UK

## Featuring

- Large conference room with air-conditioning and natural light
- Adjoining kitchen and breakout space
- Use of hydraulic & MRL lifts including access to shaft and machine room
- Fully equipped to run hybrid events with in-person and remote delegates
- All standard conference room facilities including high-speed internet, large flat screen, and refreshments
- Run your own courses or request a trainer

## Location

Bridge House is situated in Great Missenden, 38 miles northwest of Central London. The building is directly opposite Great Missenden train station (London Marylebone 45 minutes). The A413 is within a few hundred yards and provides excellent access to the M40 and M25.

## Costs

| | |
|---|---|
| Use of conference room and kitchen/breakout space, full day, 08:00 to 18:00 | £275.00 |
| Use of conference room and kitchen/breakout space, half day, 08:00 to 12:30 or 13:30 to 18:00 | £175.00 |
| Hybrid events, via Zoom/Teams or live streamed on YouTube (half or full day) | Add £295.00 |
| Use of hydraulic & MRL lifts | Add £495.00 |

Complimentary tea, coffee, milk & sugar, chilled water.
Lunch can be ordered in and will be charged at cost.

Our hydraulic and MRL lifts are also available separately for R&D projects, please contact us for more information.

WISH TO HIRE WITH US »

Contact:
office@peters-research.com
or telephone 01494 717821

# SAFed APPRENTICESHIPS

**SAFed Members are recruiting a second cohort of Engineer Surveyor Apprentices**

After a very successful first trimester of the Level 4 Engineer Surveyor apprenticeship at Fareham College, a recruitment drive is now underway for a second cohort.

The first cohort of 13 apprentices from two SAFed member companies (Allianz and Zurich) embarked on the two-year Apprenticeship programme in mid-January on a two week block release. The first session was An Introduction to SAFed, with the apprentices then covering the legal framework behind the inspection industry as well as the SAFed-CSCS Health and Safety Passport.

The Apprenticeship Trailblazers are supported by the Institute of Apprenticeships and bring businesses from each sector together to produce employer-led standards for apprenticeship roles in their industry. The first employer led apprenticeships were launched in March 2014 in areas such as energy and utilities, digital industries and financial services. Since then the Trailblazer development process has proven to be an excellent method for creating a new style of apprenticeship, based on sector needs and employer requirements.

The Level 4 Engineer Surveyor Apprenticeship provides high-quality training and on-the-job experience for learners to progress into the role of Engineer Surveyor.

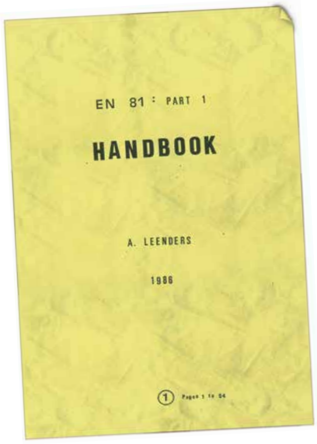
The underpinning occupational standard for the role also includes behaviours as well as knowledge and skills, which means that areas will be covered such as 'difficult conversations' and 'clear communication' which are essential.

**"I used to be a driver for Tesco, but I have always had a passion for engineering. When I saw the Engineering Surveyor Apprenticeship advertised, I knew I had to apply. It is fantastic that we are able to do our training at Fareham College's Civil Engineering Training Centre (CETC). It is one of the most high-tech facilities I have trained in, and far exceeds what I have experienced previously. Even though we have just started our training, I can see that everything I need to learn to become an Engineering Surveyor, I will learn by undertaking this apprenticeship and I am really looking forward to getting stuck in!"**
Amir Khan, Allianz, about embarking on a new career.


**"I have already completed a four year apprenticeship in Aerospace Engineering and worked for one year as an aircraft fitter, but I decided that I wanted to pursue something new. Even though I have only just started this apprenticeship, it has been really good so far. The fact that Fareham College are able to offer on-block learning, rather than day release, is of huge benefit as we are able to consolidate our learning in bigger chunks and then use what we have learnt out in the field. I am building upon my existing skills and knowledge and I am really looking forward to applying this on the job."**
Stanley Carter, Zurich, about the next stage in his career.

For further information about the Level 4 Engineer Surveyor Apprenticeship please email admin@safed.co.uk with the title stating 'Tell me more about the Engineer Surveyor Apprenticeship'. For information about Fareham College's Civil Engineering Training Centre, (CETC) please visit ***www.fareham.ac.uk/cetc***

We have already received commitment from some members to 'gift' the cost of an apprenticeship from their levy to another SAFed member. To find out more about this opportunity and the eligibility criteria please email ***admin@safed.co.uk*** or contact Chief Executive Caroline Hamilton with the title stating 'Tell me more about the Apprenticeship Gifting'.




# FROM THE ARCHIVES

**We asked Gina Barney to take a look back into her library and choose something from the archives of interest to our readers today.**

In September 1989 I became aware of a four-volume commentary entitled Handbook and comments on EN81/Part 1 Safety Code with some reference to other leading Codes by Andre Leenders of Nice, France. After some correspondence Andre sent me a copy.

The material is an authoritative source of the rationale behind BS5655-1:1986/EN81-1:1985. It documents the reasons how some clauses in the standard were arrived at. The author sometimes did not agree and called his view "controversial".

The material was not copyrighted and I queried this and Andre replied: "As a rule, I authorise anybody to make copies of my book which is not protected by any 'Copyright' because I did not write it for profit. You might consequently quote a part of my book if you wish." Thirty-three years later I am taking up the offer for **Lift Industry News.**

There are insufficient records kept of how standards are written.

*Why is 7mm the total clearance between an escalator step and skirt when either side can extend to 4mm?*

**Why not 8mm?**

*How did some of the numbers in EN81-1:1998, Table N.1 change in EN81-50:2014, 5.12.2.2, Table 2 for the same ropes?*

**Does this make lifts designed in 2013 less safe than those designed in 2015?**

Andre peeps behind the scenes into the writing of BS5655-1:1986/EN81-1:1985. No one since has followed his example in such detail. CIBSE Guide D goes some way towards it. At least on the ISO/TC179/WG10 *Energy efficiency of lifts and escalators*, on which I serve, we are creating a working group archive of all our documents and decisions.

**Can other CEN/ISO committees follow suit?**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 1998 | V-grooves | V-angle (Y) | -- | 35° | 36° | 38° | 40° | 42° | 45° |
| | | Nequiv(t) | -- | 18.5 | 15.2 | 10.5 | 7.1 | 5.6 | 4.0 |
| 2014 | V-grooves | V-angle (Y) | 35° | 36° | 38° | 40° | 42° | 45° | 50° |
| | | Nequiv(t) | 18.5 | 16 | 12 | 10 | 8 | 6.5 | 5 |

## ANDRE LEENDERS

I did not ever meet Andre, but I am sure we are similar in nature and would have a lot to debate. He was a long-time lift industry person and an active member of the early CEN committees. Leenders had a strong knowledge of EN 81-1's background. In 1981 Andre with George Gibson (U.S.), Ernest Vlahovic (Canada) and Lev Volf-Trop (Russia) started ISO/TC178/WG1. Andre retired in 1983 (and as he was French) he was probably 60. I have been unable to find out much about him, but there was an obituary published in 2005. If anyone can fill in the gaps please write to the Editor.


Avis de décès

NICE

Nous avons la tristesse d'annoncer le décès de

Monsieur Andre LEENDERS

survenu le 22 mai 2005 à l'âge de 82 ans

https://www.libramemoria.com

Lift Industry News proposes to publish extracts from Leenders (with due acknowledgement and thanks) and looks for comment from readers.

**Here is the first extract.**

FOREWORD

FWD/01: Reasons for a Safety Code

In any community where lifts are used, the need for a safety code will arise sooner or later because accidents will occur and:

- ruling authorities will want to require a minimum set of safety devices to insure a reasonable safety level for the public,
- responsible lift suppliers will welcome those requirements which help to avoid the wild competition of irresponsible lift contractors,
- manufacturers and contractors in general will need a way to prove that they have made sufficient provision for safety, considering the current state of the art, in case of accidents.

Originally, the safety codes were largely empirical.
Rules have been written and gradually added to when the recurrence of accidents prompted the code makers to issue rules to avoid such accidents. These new rules were based on existing designs and current practice, including new technological developments after the facts.

At a later stage, a more scientifical approach has sometimes been attempted for some subjects but, quite naturally,:

- manufacturers are often not favourable to rules which would impose changes in existing designs and habits,
- Governement representatives and Inspectors are, in general, reluctant to change time-honoured national practice because of the responsibility involved or the difficulty of changing existing laws.

Moreover, the necessity to gain the acceptance of the code by various groups of people who sometimes have a limited knowledge of the lift techniques, has oriented the wording of certain rules.

It should be noted also that things which are recognized as common practice are not always spelled out again in the code specific for lifts, but this "common practice" is not always the same in all communities.

FWD/02: Reasons for a European Safety Code

The E.E.C., back in the 60's, had listed, amomgst the existing "technical barriers to trade", the various national Lift Safety Codes because of the differences between their requirements. It was planned to issue a Directive for removing this barrier to trade within the Common Market and the C.E.N. received a mandate to prepare a European lift safety code which could be the basis for this specific Directive.

Beside the political decision to remove technical barriers to trade within the E.E.C., one must admit that there are no rational technical reasons for not having the same safety requirements everywhere.

FWD/03: History of the EN 81-Part I

The CEN/TC 10 was established in 1971 and appointed a Work Group N° 1 for preparing a draft code for lifts, starting with the electric ropes lifts.

Immediately, the Technical Committee of FEM-Section VII prepared a working paper based on the CIRA code and this working paper was accepted as a basis for discussions by the WG N°1.

HB:FWD Page 1

### How far have we come since 1986 to achieve Leenders' recommendations?

We have EN81-20/ISO8100-1. The problem (even in Europe) was not all countries that agree the safety standards then implement them.

Lift companies in the main are less wild and irresponsible.

We have (at least in the UK) sets of test documents and Approved Bodies to keep an eye on things, although the "Nelson" approach does happen.

Looking at EN81-50/ISO8100-2 it can be seen that empirical rules have often been converted to mathematical derivations. Just look at hydraulic cylinder design or traction calculations.

Some manufacturers who have bought a million 8mm screws find it difficult to adopt the new requirement for 10mm screws!

Government, HSE and other authorities often stand in the way of progress and publish ill-informed documents.

We have sorted out the words to employ as shall/should/can/may to have precise meanings in all languages.

Often the good practice we use in the UK fails to enter a standard. Remember we had deflector devices on escalators/moving walks long before Europe did!

## What do readers think of the progress?

## Reminisce?

### DR GINA BARNEY

*Gina Barney is well known to the world-wide lift industry, owing to her many activities in the field. Currently she is Principal of Gina Barney Associates, English Editor of elevatori, Member of the Chartered Institution of Building Services Engineers (CIBSE) Lifts Group Committee, Member of the British Standards Institution (BSI) Lift Committees, UK expert to two International Standards Organisation TC178/WG6 Traffic design and WG10 Energy efficiency of lifts and escalators.*

*Dr Barney has had a wide ranging career starting in the electronics industry, which eventually led to the award of a doctorate on four quadrant thyristor power control in 1965. After many years in universities at Birmingham, UMIST and Manchester as lecturer, senior lecturer and Director of Computer Networking, Dr Barney took early retirement in 1990 to concentrate on consultancy.*

*Her first contact with the lift industry was in 1968, when she researched Ward-Leonard lift control systems. Since then she has been active as a researcher, consultant, lecturer in the traffic design, traffic control and circulation areas. These "soft" subjects have been complimented by "hard" subjects of lift surveys, audits, contract supervision, safe release training, etc.*

*Gina is the author of over 100 papers and is the author, co-author or editor of over 20 books (not all on lifts). Her main activities currently are technical writing (she is a member of the Society of Authors) with respect to standards and publications and various training courses. She is also an Associate Member of the Academy of Experts.*

*Dr Barney has the degrees of BSc, MSc and PhD and the professional qualifications of CEng, FIEE and Eur. Ing. She was recently elected to an Honorary Fellowship of CIBSE for exceptional service to the Institution and recently admitted to be a Liveryman of the Worshipful Company of Engineers.*

# BEHIND THE SCENES AT LEIA

## Intro from Nick Mellor, MD of LEIA

2022 so far has been a busy time for the entire LEIA team, with the start-up of LEIA Assessment, our new End-point Assessment Service, organising LIFTEX, the recent LEIA Technical Seminar, a near record number registering for the May distance learning start, as well as our more regular work to support the sector. Every issue we'll bring you an update from members of the team on our different projects and priorities from all of us here at LEIA.

**One of the best parts of my job is getting out and seeing members, new members and prospective members. After chatting about LEIA's work, people often remark "we didn't realise LEIA did so much" or "LEIA shouldn't hide its light under a bushel". So, it is good to be recognised for an award by the European Lifts Association (ELA) as Oliver Greening describes below.**

We have been working with government (BEIS) on issues arising from new UKCA-marking requirements so were pleased that in August 2021 the implementation date was postponed to 1 January 2023. We have just heard that the Government has announced some relaxations on UKCA marking of spare parts and on the duties of importers – key issues we have been working with Government on for several months.

That date is now approaching quickly, and work goes on with BEIS to find ways to ameliorate the impact of the new rules.

The Building Safety Act received royal assent on 28 April and has attracted much attention as it will have far-reaching implications for the construction industry.  This is a part of legislative changes which will also include changes to fire safety regulations and a raft of regulations supporting the Act with more specific requirements.

Related to this issue, LEIA has published guidance relating to lifts, fire resistance and lift operation in the event of fire. A particular focus is on evacuation lifts where we have given presentations at the LEIA Technical Seminar, CIBSE Lifts Group seminars, the ASCP conference and will be at the Lift & Escalator Symposium in September.

> "we didn't realise LEIA did so much"

### Membership and LIFTEX update from Oliver Greening, Senior Operations Manager

We're halfway through the year, and we have already welcomed a number of new members to LEIA including contractors, maintenance providers and component suppliers. It's always fascinating to learn about our new members during the approval process, many of whom are family-run businesses. We're really looking forward to working with them all.

After a three-year gap, LIFTEX is back this October at London's ExCeL, and I'm pleased to report that things are looking positive. Despite the past few years of uncertainty, sales for the event have flown.

In other news, we were delighted to be awarded the 'Outstanding Association Award 2021', shared with the Fédération des Ascenseurs, back in May from the European Lift Association during its general assembly and conference.

**Credit: ELA**

## End point assessment update from Karen Slade, Head of End Point Assessment

I can't quite believe I have recently celebrated my one-year anniversary as Head of End Point Assessment for LEIA, and it has been six months since we received recognition from Ofqual. Time has flown by, and we have now started to welcome our first cohort of apprentices through for end point assessment.

It has been a productive year, setting up the service, recruiting and training assessors and launching the website ***https://www.leia-assessment.co.uk/*** which is the brand name for the LEIA End-Point Assessment Organisation.

In case you're not familiar with LEIA Assessment, we provide specialist EPA to the lift and escalator industry (and connected sectors). We are approved to offer end point assessment for two apprenticeships:

- ST0252 Lift and escalator electromechanic – Level 3
- ST0251 Stairlift, platform lift, service lift electromechanic – Level 2

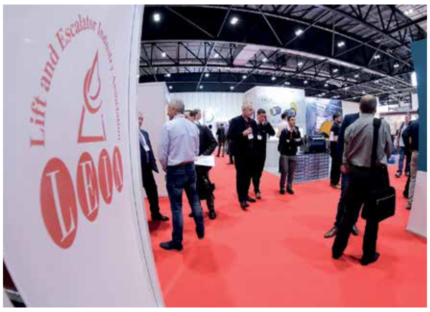
Our role also involves supporting employers and training providers throughout the apprenticeship process with the view to preparing apprentices for EPA, and we have specialist resources in a dedicated knowledge hub. We're also running virtual support sessions to ensure the assessments go smoothly and we provide pre-assessment checks to put the apprentice at ease.

The ethos at LEIA Assessment is supporting to succeed, we believe that the more prepared and informed apprentices, employers and providers are, the more likely they are to succeed.

LEIA as a trade association, is embedded within the sectors we deliver to and every apprentice who takes their EPA through us will be treated as an individual and will receive a personal, bespoke service, they will never be just a number to us. Our sole focus is to provide robust assessments so that new entrants into the sector are qualified and skilled to the highest level.

The LEIA Assessment Independent End-Point Assessors, and Internal Quality Assurers are all associates from the sector with specific and current experience qualified in assessment and /or quality assurance. We believe that there is no-one better to assess the lift, escalator and stairlift electromechanics of the future than those who are at the forefront of installation / maintenance and repair.

We're actively seeking to expand our offering to include a range of relevant end-point assessments so do get in touch if you have any suggestions.



If you're starting an apprenticeship scheme and want to discuss the requirements of apprenticeships or either of the standards above or just want to know more, then please do visit ***https://www.leia-assessment.co.uk/*** and get in touch if you would like to chat: ***karen.slade@leia.co.uk***

## Distance learning and training update from Dan Charlesworth, Training & Safety Manager

During lockdown we saw a peak in uptake of distance learning, which comes as no surprise. So, we're thrilled, despite it being 'business as usual' for most of us, that this trend has continued. In fact, our May intake this year has seen a 20% increase in enrolments.

For those not familiar with LEIA Distance Learning, it's a technical training programme of study which aims to extend the candidate's knowledge of lift and escalator engineering. It has been designed by, and for, the lift and escalator industry to address the difficulties created by a highly mobile workforce and the demands of changing British and European standards requirements.

The course is divided into Full and Half units of study. The full units cover engineering principles, lift technology, electric traction lifts and hydraulic lifts. The half units cover lift and escalator technology, safety and commercial management. Candidates will then receive the Certificate of Unit Achievement issued by LEIA and IOSH Certificate after MSH4 (Managing Safely).

Courses start on 2nd January, 1st May and 1st September. Enrolments close two weeks before each date.

Get in touch if you would like to find out more. Email ***Enquiries@leia.co.uk***

# SAFETY FIRST

Our undercover Industry Expert keeps you up to date

## Proving Competence and the Value of Toolbox Talks

**Competence falls into three areas – Knowledge, Skills and Behaviours.**

**It not only covers the ability to do a task properly but also how safe someone is (their behaviours).**

### HOW DO WE PROVE THAT OUR STAFF ARE COMPETENT?

When incidents occur, early questions often include, "What training has the injured party had?" It often surprises me, when investigating accidents, that contractors can't find training records for their employees.

Toolbox talks are a good way of providing and recording regular updates to field staff in a convenient and effective way, reinforcing the safety message throughout the workforce and enhancing the development of a safe working culture.

These sessions also support the Continued Professional Development (CPD) that professionally qualified and registered engineers are required to undertake, to maintain their registration with EC UK (The Engineering Council) and their PEI (Professional Engineering Institution).

### ENHANCING SAFETY CULTURE

The safety culture of a business is an important factor in avoiding accidents, increasing staff awareness with the potential to reduce accidents, downtime and equipment damage, possibly even save a life.

Toolbox talks cover safety aspects related to specific jobs. Meetings are normally short and include topics such as work-related workspace hazards and safe work practices.

Acting as a great refresher, these sessions keep the employees abreast of changes in regulations, safety procedures, equipment, personal protection equipment (PPE) and job assignments and responsibilities. It is a very effective method to update workers' knowledge.

'It is a very effective method to update workers' knowledge'.

## STRENGTHENING RECORD-KEEPING

There is often a human factor involved in accidents, such as rushing, taking short cuts or not concentrating. Keeping good records of training ensures that, when an accident occurs, it is clear to see if relevant, appropriate and timely training has been carried out.

I was once involved in a case where an operative was injured whilst working on a lift. A few weeks before, they had received a toolbox talk on the very subject surrounding their injury, and this proved vital for the directors of the company in proving that the operative had been trained to complete the task properly, but had disregarded this training in a bid to get the job done quickly. Keeping good records was essential to form a defence. Reputational damage to a business is a consideration when working to enhance safety culture.

## ADHERING TO INDUSTRY STANDARDS

Refresher training is required by law on some topics, and planned safety talks are a convenient way to go over essential training. Toolbox talks also show a commitment to the "Safe working on…." series of British standards including:

- BS7255 Safe working on lifts
- BS7801 Safe working on escalators & moving walks
- BS9102 Safe working on lifting platforms

Additionally, it is essential that staff understand their statutory duties to themselves and anyone who may be affected by their work. These responsibilities are clearly set out in The Health & Safety at Work Act as well as other statutory instruments that affect our industry.

## PLANNING TOOLBOX TALKS

Effective toolbox talks can save lives. The fundamental factors are brevity, authority, relevance, clarity and accountability. Toolbox talks should:

- Promote safety awareness. Workers get actively involved in safety matters and reduce safety risks.
- Introduce workers to new safety rules, equipment, preventive practices and motivate workers to follow standard operating procedures.
- Provide vital information to the workers on accident causes, types and preventive actions.
- Emphasise planning, preparation, supervision and documentation.
- Help when reviewing new laws or industry standards, company policies and procedures.
- Encourage workers to discuss their experience and help to review safety procedures in future.
- Promote a culture that avoids short cuts.

Toolbox talks can be carried out virtually, on a device, anywhere. Online toolbox talks, specific to our industry are available and can assist in making operatives more aware, as well as keeping accurate training records for you.

> 'Effective toolbox talks can save lives'.

# THE INTERVIEW

Stannah is a stalwart of the lift industry, proudly family-owned and run, and with a rich history spanning 150 years and five generations. We sat down with Group Director responsible for UK lift and service businesses, **Alastair Stannah**, to hear more about his vision for the company, and to gain a little insight into his role as LEIA President.


### Q: Stannah is THE name in stairlifts, but with over 150 years in the lift industry, can you tell me where Stannah began, and where you are now?

A: Our origins go back to my great-great-grandfather, making cranes and hoists for the docks in London. The business then evolved into lifts, and whilst we are well known for Stannah stairlifts, we make passenger, platform and service lifts as well as home lifts, escalators and moving walkways. We are now the biggest independent lift manufacturer, five generations later.

### Q: So much has changed over the past 150 years, have you seen that reflected in your values as a company?

A: In many ways, our values have remained consistent, going back to my great-great-grandfather, Joseph Stannah, in the 1860s. He was an innovator, an inventor, but also a good businessman, and he had principles. We found in his papers the '12 Rules for Life', and while some of them may read a little bit old fashioned, some of them ring very true today. We take great care to respect and support our people and we recognise that it's the efforts of many people over many years that have got us to where we are today.

Our customers always come first, without them we wouldn't have a business, and safety and quality are really important – the safety of our products as well as our people doing their jobs.

### Q: What's next? What are Stannah's top priorities?

A: Coming out of a very disruptive couple of years, we'll still see the reverberations for a while yet, especially with the effect on global supply chains, so we'll be working hard to protect our business and our customers. We're building a new factory in Andover as well as one in the USA so we can improve our lead times over there.

We're expanding other facilities in the UK as well as Czech Republic, investing in our operations and our products to ensure our customers get the best possible products and service. We're really excited about the future as a British company, growing our global focus.

### Q: Sustainability is increasingly important for businesses to play their part in – how is Stannah addressing the goal for net zero carbon emissions?

A: As a business, we recognise that we have an impact on the environment and are increasing our efforts on sustainability. We now have a dedicated sustainability manager and are developing our policies, setting ambitious and challenging targets for carbon reduction. We know that we must play our part, not just complying with legislation, but doing everything we can to reduce carbon emissions. We know there is work to do, so we are putting more effort and resource into reducing our impact on the environment.

### Q: With a focus on safety for this issue of Lift Industry News, can you identify your top safety focus?

A: Safety is and will always be a big focus of ours, it's ingrained in our business – safety comes first. We invest time and money to ensure our people are working safely and that our products are safe. Service engineers undertake three days' training when they start to ensure they're trained to Stannah standards, and then we hold regular briefings, toolbox talks and it's always the first thing on the agenda at relevant meetings. We have our 'Golden Rules' that underpin our safety stance and also work with LEIA – we have a representative on the safety committee. It's a continual, ongoing focus for us.

### Q: What do you think the lift industry could be doing better to promote safety as a top priority?

A: I don't think there's a single thing that needs to change. I think it's about making sure products follow the standards and also that the right specification is chosen for the right application. Behavioural safety is a priority, making sure that safety is ingrained in what we do – much like we get in a car and automatically put our seatbelt on, doing the right thing should be second nature, a habit. We need to make an ongoing effort with training, using different styles of training to speak to different people.

### Q: As LEIA President, what is your top priority?

A: My main priority is to support the team at LEIA who do a great job on behalf of the industry and the membership. Our main area of focus at the moment is the post-Brexit product certification, moving from the CE mark to the UK CA certification which has required a huge amount of work by the industry, having to approve all the products and components to the standards. There have been challenges along the way – it takes time to set up new approval bodies – and there's still a significant amount of work to be done before the end of the year. LEIA have been instrumental in highlighting what's required and then lobbying Government to ensure we have realistic timescales to get the work done.

Another main focus is our response to the Building Safety Act that came about after the tragic fire at Grenfell Tower. This places additional responsibilities on lift companies, whether that's when we're installing a new lift or within the management of buildings. We understand how important it is to play our part in improving building safety.

### Q: Why is it important to you to be a member of LEIA?

A: My grandfather was a member, so we've been part of LEIA for a long time. It's important to work with others in the industry to improve safety and reduce accidents, as well as raising standards in the wider field, improving products and ensuing there's a level playing field. As an independent body, LEIA supports the industry, whether that's lobbying Government or other stakeholders in making sure our voice is heard consistently. We have a representative on every LEIA committee, and we understand that it's important to support them – LEIA only works if the members give something back.

## Q: How do you think the industry can attract new talent?

A: Recruitment has been a great challenge across the industry over the past few months, so it's important that we reach people and encourage them to explore potential careers. Another main focus within LEIA is bringing the next generation through and LEIA has become an endpoint assessment organisation to help with this. There is also a LEIA microsite online that showcases what it's like to work in the lift industry, with links to members that offer vocational training. Apprenticeships are a key tool in delivering training and providing a way into the industry, and we're keen to reach people in schools and help them explore apprenticeships and NVQs. This is something we've offered at Stannah for many years, and we've seen people join us as apprentices and rise up to senior positions.

## Q: What's been the highlight of your career so far?

A: There's not been one highlight, but as of July 2022 I've worked for Stannah for 25 years. I was asked to mark this milestone with a few notes on my career, and so I've been looking back at where I started, as a Technical Sales Engineer, selling passenger lifts in London. I still remember my first appointment, which actually turned into my first order! I learnt a lot from that and it was a great introduction to the company. My third job was manager of an assembly cell in our stairlift factory, a big change from working in a small office, and a steep learning curve, moving to manufacturing, with a desk on the factory floor! I am very lucky to work in the family business with a lot of great people around us who have contributed to getting the business to where it is today and I feel very fortunate to be in this position.

Thanks to Alastair for sharing some pearls of wisdom, and congratulations for 25 years with Stannah!

To find out more about the company, visit their website – **www.stannah.com** – and explore more about LEIA membership at **www.leia.co.uk**.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## 1. Enhancing the I-S-P method (Inverse Stops-Passengers) using the Monte Carlo simulation method

Lutfi Al-Sharif - Al Hussein Technical University, Jordan; Richard Peters, Matthew Appleby Peters Research Ltd, UK

Previous research has developed a method to infer the number of passengers that the elevator car is carrying based on the number of stops that it makes in the up-direction or the down direction (1992). The method was denoted as the I-S-P method (or the Inverse Stops-Passengers method). The application of the method was found to be sensitive to the prevailing mix of traffic in the building (e.g., incoming, outgoing or lunchtime). Developing those equations analytically becomes mathematically complex.

This paper will use the Monte Carlo simulation method to numerically develop the ISP relationship under any mix of traffic (i.e., by using the percentage of incoming traffic, outgoing traffic and interfloor traffic), without the need to resort to deriving analytical equations. The main advantage of such an enhanced tool is that it can be used in real time to infer the number of passengers inside the car by simply monitoring the stops, under any type of traffic.

## 2. Impact of lift floor area usage information on passenger service level

Diana Andrei, Mirko Ruokokoski - KONE Corporation, Finland

A lift stop is unnecessary if a lift stops to serve a call, but no passengers enter or exit the lift. There are some reasons for such a situation. For example, a passenger accidentally makes a call to the wrong floor, or a lift stops to pick up passengers, but no one enters the lift car since the waiting passengers consider the car full. In this paper the focus is only on the latter case. Traditionally, such unnecessary stops are eliminated by using a bypass load feature. In this feature, a lift starts bypassing registered landing calls when the car is recognized to be loaded over a certain limit, called bypass load. Usually, this limit is 60 – 80 % of the rated load. When there are only passengers moving, the bypass load feature works well in reducing unnecessary stops. Nevertheless, when passengers transport light objects with them, such as luggage or shopping carts, the floor area of a lift car could be fully occupied, but the load is still below the bypass load limit and as a result, unnecessary stops may occur. If information about floor usage of a lift car is accurately known, i.e., what is the occupied percentage of the lift floor area by passengers and objects, unnecessary stops will be better prevented. This paper studies how much waiting times and journey times of passengers, as well as the number of unnecessary stops are affected when the floor usage information is used, in addition to load, in the bypass feature. A large set of hypothetical cases is analyzed to see how these performance measures are dependent on different factors. The set is formed by varying traffic intensity, traffic type, number of objects transported and their sizes, lift group size, and floor area usage limit.

## 3. Generation and application of dynamic lift kinematics

Matthew Appleby, Richard Peters, Nishad Deokar - Peters Research Ltd, UK

Performance time is a measure of the time it takes a lift to travel between floors and is crucial to delivering the highest possible handling capacity and lowest passenger waiting times. To calculate performance time and to enable a lift to deliver a comfortable trip leads to a need to understand lift kinematics.

Lift kinematics is the study of the motion of a lift car in a shaft without reference to mass or force. When generating lift kinematics, it is normal to consider the travel distance, velocity, acceleration, and jerk; these inputs can be used with well-known equations to determine the time in flight, and a reference speed profile for the lift drive. However, in advanced lift applications, there are additional requirements for the deceleration not to be the same as the acceleration. The jerks may also be different and sometimes it is desirable to change speed part way through a trip. This paper addresses the generation of dynamic lift kinematics to meet these requirements and discusses their application.

## 4. Design-operation continuum methods for traffic master

Aitor Arrieta, Goiuria Sagardui, Aitor Agirre - Mondragon University, Spain; Maite Arratibel - Orona, Spain

The lifecycle of lifts could last up to 30 years. As any other electrical or mechanical component, software of lifts also require a maintenance process. Maintenance copes with (1) hardware obsolescence and/or degradation, (2) bug fixing, (3) new functionalities, (4) requirements changes, etc. This evolution requires reliable and automatic engineering methods for developing and operating lifts. Advances in the last few years have resulted in more efficient development process, improving modelling and simulation techniques to validate complex systems from the early phases of development. However, once the system is deployed, methods used during operation and maintenance do not have synergies with methods used during the design. The steps from the development to operation, i.e. testing, delivery and deployment, often require certain manual work to guarantee reliability. Current software development approaches are not applicable or require extension for lifts, where evolution is constant. Furthermore, learning from operational data to enhance the design is becoming a necessity in this sector.

The ADEPTNESS project seeks to investigate and implement a streamlined and automatic workflow that makes methods and tools for the software development and maintenance of lifts to be seamlessly used during design phases as well as in operation. The ADEPTNESS framework uses a novel embedded microservices-based architecture for the context of lifts. The generation and reuse of test cases and oracles from initial phases of the development to the system in operation and back to the laboratory for further analysis will be investigated. This will guarantee a faster and more reliable detection of faults before a new software release is deployed into the lifts installations. This deployment will be automatic and synchronised to improve the agility of the whole workflow that covers design-operation continuum. Additionally, test oracles will run both at design-time as well as at operation, permitting the continuous validation of a software release.

## 5. Rated load and maximum available car area. A proposal to revise en81-20, table6

Gina Barney - GBA, UK

In the USA during the 1920s concerns were expressed that large lifts were being overloaded owing to the lift attendants in the cars pushing passengers into their cars. On group systems this was aggravated by the human despatchers forcing passengers into the cars. The result was the density of the passenger load increased as the cars got bigger. Non-domestic buildings were designed in the USA for a uniformly distributed load of 60 pound per square foot (psf) on open areas of building floors and this was used for lift car floors. To ensure passenger safety the load bearing was increased to 100psf for lifts carrying 10,000lb (A17.1:1925) and in 1937 to 127.5psf (A17.1:1937) for lifts carrying 37,500lb. This resulted in a nonlinear relationship between passenger load and the available car area on which they stand. This can be seen in Table 6 of EN81-20:2020/ISO8100-1:2019.

Societal changes, where individuals do not tolerate the discomfort of other individuals intruding into their personal space; and technological advances in load weighing, demands a reconsideration of the space a passenger occupies and its corresponding rated load. A proposal to revise the relevant standards is presented.

The concept of a Body Area Index is introduced to allow for a wide range of body weights across the world.

## 6. Towards a global traffic control (dispatcher) algorithm –interface prototype design

**Jonathan Beebe - Jonathan Beebe Ltd, UK**

This paper presents an overview of the design and development of a prototype Global Dispatcher Interface (GDI) for the control of a group of lifts. The role of the dispatcher is to assign passenger calls to the optimal lift in a group, as decided by a dispatcher algorithm. The GDI is independent of the underlying algorithm, which may be distributed remotely. To warrant the "Global" appellation the GDI must support any currently available, as well as anticipated, call station modes, types and configurations of cars, distributed control equipment and buildings.

The design process is a continuation of a recognised Software Development Lifecycle, centred on Use Cases in a UML model, the initiation of which is covered in a previous paper. Significant diagrams from the model are presented and discussed to illustrate the evolution the prototype design. One of the requirements, resulting from analysis of the Use Cases, identifies that the GDI design must be compatible with a publish-and-subscribe architecture and a RESTful interface is selected for this purpose. Where possible, the prototype design uses open standards with an emphasis on demonstrating aspects that are specific to lift system dispatcher operation. The Standard Elevator Information Schema is particularly relevant and fulfils both these objectives. The operation of the working prototype, in conjunction with simulated lifts and passengers, is presented as a validation of the design.

## 7. Lift industry and BIM: a long overdue adopted and typically overlooked project enabler

**Miguel Castro - Schindler Ltd, Swtizerland**

BIM (Building Information Modelling) shall not be a new term for any individual or enterprise working in the construction industry. However, the Vertical Transportation industry still finds the use of BIM as rather "new" despite being mandatory in certain countries for all public projects since a few years. BIM has proven itself as an enabler for different actors inside the construction industry: Investors, Builders, Lead Designers and Facilities Manager can benefit from a faster and more accurate deliverables creation.

The digital models of the elevators and escalators are fully integrated and coordinated with the architectural and structural models since the beginning of the project which leads to a quicker design approval and therefore, a faster release to manufacture. All this combined with the reduction of the mistakes on site leads to a higher customer satisfaction rate.

The use of BIM models during the operational phase is becoming more and more important with the raise and the need to provide Digital Building Twins. BIM Models are the foundation of the Digital Building Twins and therefore these shall be accurate and contain the relevant information for the Facilities Managers. Accurate and up to date models (these need to reflect the current condition of the installed assets) can also serve as a solid foundation to plan modernisation jobs. The raise of drone surveying as well as 3D laser scans could be of great use to modernisation teams looking to install new products into existing buildings.

## 8. IoT applications for lifts - Earlier identifications of faults

**Paul Clements - D2E International, UK**

The original research for this paper was undertaken to determine the possibilities of utilising IoT technology to monitor the condition of lifts and understand if they can be used for earlier detection of faults.

A sample set of lifts were selected from a client's diverse portfolio to analyse callout data over a 13-month period with comparison to responses to a questionnaire, issued to various stakeholders within the lift industry, and with information gleaned from the authors literature review. A small-scale experiment using low costs IoT sensors was then conducted on some of the lifts within the sample set and on one lift where a separate client approached the author to trial the system.

The callout data and the questionnaire results showed that there are various common faults that could be monitored and identified using IoT technology which would assist with earlier diagnosis. The experiments conducted provided an understanding of how a low-cost system could be used to assist with earlier fault detection and condition monitoring of lifts, along with an understanding of the typical issues faced by the major lift suppliers (e.g. signal and internet connectivity issues).

To conclude, major lift companies such as Otis, Kone, Schindler and ThyssenKrupp are spending large quantities of R&D budgets to develop integrated sensors for new installations and retrofitting systems for their current install base. Independent companies may not have the budgets available to develop these systems, however, this report shows that readily available sensors can be purchased and retrofitted to lift systems to assist with condition monitoring and earlier fault detection without the need for heavy investment. Since the original study, the lift industry has also moved forwards and third part systems are starting to offer independent suppliers the opportunity to utilise IoT to assist with maintenance insights.

## 9. The Woodstock lift

David Cooper - LECS UK Ltd, University of Northampton.

In 1938 Keighley Lifts installed a lift in a private dwelling that is still running today. It has many features from heritage lifts that would no longer be acceptable or wouldn't comply with modern standards however, as a piece of engineering heritage the lift is quite stunning. Its features include a floating floor, round guides, idle line, rope operated overtravel limit, Ellison circuit breaker, 200 volt supply with a static phase shifter and so on.

This paper will highlight to younger members of the lift community the type of equipment that was still in use and being serviced in the 1980's.

## 10. The investigation and development of a fire protection system for the lift industry applications.

Mateusz Gizicki, Stefan Kaczmarczyk, Rasoul Khandan - The University of Northampton, UK; Brian Henderson, Neil Clark - EES UK Ltd, UK

The research aims to develop a bespoke shaft fire protection system for the lift industry applications using numerical simulation and experimental testing. The model, thermal conductivity properties of the fire-resistant barrier will be supported and validated against experimental data available from previous research and generated as a part of this project. Data gathered in a process of the simulation will offer information on pressure distribution and temperature differences between divided compartments as well as on the fire protection body.

The developed optimized model can be then used to examine the effectiveness of the system and to evaluate its efficacy as a prevention system to mitigate stack effects. Additionally, an approximated model of the system can be used in large-scale buildings simulations. Exploring pressure and temperature distribution in such buildings would give a good insight into the effect of the lift shaft on possible fire and smoke propagation.

## 11. IoT safety predictive monitoring of lift operations, shafts and buildings

Andrew GorinSpecialist Lift Services Ltd, UK; Roberto Zappa - IoTSafe s.r.l., Italy

There is a lack of single reliable and cost-effective solutions for Lift and Building health monitoring systems that are suitable for both lift and building.  A purposely designed safety device could turn any lift into a building structural monitoring system that enables continuous remote monitoring and real-time diagnostics of both the operational status of lifts and health of building structures.

A cloud-connected sensor package would continuously track variables like vibrations, acceleration, displacements, and other physical phenomena. The data gathered from the specifically positioned sensors would be wirelessly transmitted to the cloud and screened via bespoke analytical software using reliable specific algorithms based on machine learning and cognitive computing.

As a result, any lift or building anomalies can be detected in real-time. Users can receive alerts, notifications, and reports, through our dashboard, on smartphones, tablets, and PC for further analysis. This allows lift Companies to plan and act prior to breakdowns, damage, or accidents, subsequently reducing their financial costs (predictive maintenance).

The reading combination of data would increase people's overall safety, optimize maintenance, improve performance, and protect the long-term value of assets. Buildings and lifts are prone to a gradual ageing process. In accordance with EU Commission data, about 80% of EU building stock is over 25 years old and people spend approx. 86,9% of their life inside buildings, including lifts. All buildings are subject to hazards, fast-growing urbanization, nature, including earthquakes, landslides, floods etc. Progressive deterioration or defects of building structures and lifts are, in most cases, are hidden and evolve unnoticed until a failure occurs.

Currently, lift and building maintenance is based on several periodic inspections, resulting in high costs and low efficiency causing CO2 dispersion.  A purposely designed safety device can provide a solution to monitor lifts and buildings 24/7/365 remotely by using the lift shaft as a vector. A user-friendly solution which enables an accurate maintenance planning, therefore reducing the number of site visits, to the ones needed.  This reduces traffic and personnel on the road making unnecessary site visits, helping to generate a more efficient ecosystem.

## 12. Elevator IoT: turning sensor data into value

Michele Guidotti - Cedes, Switzerland

When companies talk about IoT – the "Internet of Things", which typically refers to a system or device with sensors, a network for transmitting data, and a system that can process and trigger actions, it is today far more than just an industry buzzword. IoT is a critical part of turning data into value that can lead to improvement in operational efficiencies, reduced maintenance costs, and even real-time system adaptations for improved system performance. Most importantly, data is at the heart of any IoT product. In today's elevator systems, there are already plenty of sensors installed for various functions, however the full potential of the data out of these sensors is by far not yet exploited.

Sensors' data can be turned into useful information for the elevator companies, for the real estate owner and facility manager as well. IoT and Autonomous Decision Making can dramatically enhance the elevator companies' efficiency. Real scenarios and the real benefits will be explored.

## 13. Disinfection efficacy analysis of UVC device for escalator handrails

Qingping Guo, Andrew Kenny - EHC Canada, Inc; Johannes Guentsch - Draka EHC, Germany; Benjamin Hatton, Dalla Asker - University of Toronto, Canada

The global Coronavirus pandemic is of urgent concern with its high transmission rate and rapid spread throughout the world from 2019.

This paper introduces a UVC device to be fitted on escalators which was designed to inactivate bacteria and viruses on the surfaces of handrails during escalator operation. The authors describe how the UVC device works and detail the disinfection efficacy of the device to inactivate bacteria and viruses.

In this work efficacy of the device against two bacteria (E. Coli and S. Aureus) and two viruses (HCoV-229E and HCoV-OC43) were tested. All tests were conducted in two modes of the UVC device: continuous mode and pulsed mode. Based on the test results and combining UVC parameters, the disinfection efficacy of the UVC device was analyzed. The investigation found, i) the relationship between the disinfection efficacy and the UVC parameters of the device, ii) the relationship between the disinfection efficacies between continuous and pulsed test mode and iii) the D99 of the UVC device for the two bacteria and viruses based on escalator operation.

## 14. Designing a vertical metropolis - case study of STH BNK by Beulah complex

Mateusz Jankowiak -
Arup, Australia

This paper aims to take a closer look at various vertical circulation challenges associated with the ongoing design of STH BNK by Beulah development in Melbourne, Australia. Currently, the complex consists of two towers connected by a common podium and features a vast range of offerings.

The 101-storey (368m tall) East Tower would become the tallest in Australia and will include luxury residential units as well as a publicly accessible Conservatory at the top of the building. The 63-storey (290 m tall) West Tower will feature a luxury hotel and hotel branded residences located above commercial office levels. The 9-level podium will include mixed retail areas, several restaurants, wellness facilities, a childcare centre, a large auditorium, a high-end exhibition centre along with a rooftop public garden. The complex's 7-storey basement will include commercial and residential loading bays as well as car and bicycle parking.

Midway through the concept design stage, adjacent property was added to the site resulting in the West Tower and the Podium increasing in size and the East Tower having hotel branded residences introduced requiring dedicated circulation while maintaining the original core design.

The current vertical transportation design for the overall complex includes approximately 60 lifts and 25 escalators. All commercially available technologies are being considered in the design including TWIN, double-deck, single-deck and machine-room-less lift arrangements. Sky-lobby approach is used for the hotel in the West Tower with the guest lifts on upper levels being stacked above the office lifts for core efficiency. Destination control is being using in the East Tower in order to allow separate circulation of hotel branded and traditional residents.

Given the physical constraints of the site, active traffic management of some of the publicly accessible facilities as well as other design compromises may be required to balance functionality with constructability.

## 15. Vibration signature and the application of intelligent pattern recognition in detection and classification of damage in automatic power operated lift doors

Stefan Kaczmarczyk, Rory Smith, Mateusz Gizicki - University of Northampton, UK.

Maintenance data collected from lift installation sites demonstrate that the majority of faults occur in door (entrance) systems. Wear and tear of the door operator mechanism and the door system components/ subsystems will result in defects that lead to damage which in turn leads to faults, understood as a change in the door system that produces an unacceptable reduction in the quality of its performance.

The research presented in this paper involved the development of an experimental lift door stand to collect vibration signature datasets corresponding to a range of typical damage classes that occur in lift door systems. The installation comprises single speed doors (single panel side opening and two panel centre opening) as well as two speed doors (two panel side opening and four panel centre opening).

Once the data are collected the vibration features are extracted and used in supervised learning to train the artificial neural networks designed to recognize patterns and to classify damage. The results obtained demonstrate excellent performance of the network with very high percentage of correctly classified damage classes involved.

The work completed so far forms the basis for the development of decision stage algorithms to analyze the results from the pattern recognition and to decide about appropriate maintenance actions required.

## 16. 1927 - a year that set direction of traction lift engineering for a century

Jaakko Kalliomäki- KONE Corporation, Finland

Nearly a century ago in 1927 F. Hymans and A.H. Hellborn published their famous book "Der neuzeitliche Aufzug mit Treibscheibenantrieb" (Modern elevator with traction sheave drive), which had a major impact in the introduction of traction sheave elevators to the European Market and laid the groundwork of modern lift engineering. The book explains the function of traction sheave lifts, theory of traction calculation and several other key principles of lift engineering.

A less known but also important book was published on the same year by H. Donandt. His dissertation "Über die Berechnung von Treibscheiben im Aufzugbau" (On the calculation of traction sheaves in elevator construction) touched some of the same topics as Hymans' and Hellborn's book, but merits independent recognition.

A major handicap in understanding the background of modern lift engineering is that to this day neither of the books have been translated into English for the wider lift engineering audience.

This article gives an overview on the content of these books and explains how these two books differ in their approach. The article also briefly introduces the authors and the historical framework of these books. Parts of these books that have had significance to this day are given specific attention.

## 17. Component based modular elevator

Kasinadh Karra - VTI Global Vertical Transportation Consultant, United Arab Emirates.

This paper briefly addresses a "Component-based Modular Elevator" (CBME) design. The idea is to have readily available components (mechanical, electrical & electronic) of an elevator ideally in a local warehouse, that are totally modular in nature, easily configurable to build one entire elevator system. This method facilitates easy procurement, deployment, and installation of the elevator without a need of placing an order with the manufacturing plants (OEM)/ logistics centers .

The elevator industry supply chain includes all the processes involved in ordering, producing, shipping, and other logistics delivering to the construction sites. The local selling companies do not have manufacturing plants but import the materials from their principal factories' world over (mainly from China & Europe).

Modular design is a method of breaking down a system into smaller sections/modules that can be constructed individually and then combined to form a larger system. From less customization and design flexibility, modularity also has advantages, such as augmentation ( modernization). The design aims to combine the benefits of standardization ( low manufacturing costs) and customization.

Traditionally built elevators still need to be manufactured as per specifications, even if they are standard models. Whereas, from a segmented modular elevator design, different models of elevators could be built up using segments that can add up to have different capacity elevators using prefabricated elevator modular mechanical & electrical components. The concept of modular elevator design was always present, but not at the component level. The advantage we can gain from such a design is that the parts can be pre-ordered (or 3D printed), stocked, and these can be assembled at the job site to suit the specification.

A methodology proposing CBME essentially takes a specific modular design of major components of an elevator application as an example to show the development of a fully modular elevator.

## 18. System simulation for fault analysis of lift doors

Matti Lin, Gabriela Roivainen - KONE Oyj, Finland

Increasing urbanization level have led to rise in importance of lift product reliability. Lift doors as a mandatory safety component are the most frequent reason for maintenance needs in lift systems. Therefore, overall performance of lift systems can be improved effectively by improving reliability and maintainability of lift doors.

System simulations enables new possibilities to perform malfunction simulations to recognize root causes and malfunction indicators linked to the most critical failures in lift door systems. The method utilized for the approach is called object-oriented modelling where elements from all areas of engineering are connected to each other as building blocks. The elements include components from lift door drive systems, power transmission and mechanical components which are interconnected forming a complex system simulation model representing the physical lift door systems.

The approach provides explicit outputs of each included element of simulated systems in time domain. In this paper, the outputs of door drive system are utilized for performing fault analysis which includes motor encoder data and torque output. Multiple malfunction simulations have been computed and validated with data acquired from physical counterparts of the simulated lift door system. The validation results have proven the credibility of simulations and have demonstrated new opportunities to utilize the simulations for developing fault diagnostics.

## 19. Investigation into the closing force of passenger/ goods lift automatic power operated doors and recommendations to reduce the risk of injury to lift users

Daniel Meekin - Zurich Engineering, UK

There are feelings within the lift industry that the risk of entrapment injuries to lift passengers caused by excessive closing forces of automatic power operated doors can be reduced. This project investigates if concerns are valid where lifts are operating with non-compliant door closing forces. The paper aims to provide measures to reduce entrapment risks to lift passengers, which is important because most lift related injuries are associated with lift doors.

Findings documented within this paper highlight a high risk of entrapment injuries due to numerous factors, even with modern lifts that conform to the latest design standard. Due to evidential risks to lift passengers, the safety of similar powered door systems is investigated and compared to lift door systems and it is found that multiple improvements can be made due to these comparisons.

Closing forces are the final line of safety and controlling them can mitigate injury risks. Extensive field research carried out using data from in-service lifts confirms that lifts are in operation with force thresholds being exceeded. This presents increased risk of injury to lift passengers. Closing forces and other data gathered during field research is analysed to recommend a measurement procedure for implementation during routine Thorough Examinations. Implementation of this procedure will directly improve the safety of lift passengers, while reducing risks of prosecution to individuals and businesses certifying lift safety, if an entrapment injury occurs and forces are found to be non-compliant.
In addition, improvements are recommended to lift owners/duty holders and BSI to further increase the safety of lift automatic power operated doors.

## 20. Challenges to drafting a standard for lifts for the evacuation of disabled people

Nick Mellor - Lift and Escalator Industry Association, UK

A standard for the design of a lift to be used for the evacuation of those who cannot easily use the stairs (an evacuation lift) needs to respect different strategies for the management of evacuation of a building and, in the case of evacuation due to fire, needs to be based on the building design protecting the evacuation lift for at least the duration of the evacuation.

Yet building design and management aspects vary according to the type of building and are subject to national building regulations which vary across different territories. This might partly explain a lack of convergence of evacuation lift solutions during a period where the use of lifts for evacuation has been widely discussed.

In looking at evacuation lift provision, how many people might need or wish to use lifts for evacuation and how can those most at need be prioritised? These challenges are discussed with reference to the development of a draft European Standard prEN 81-76 for evacuation lifts and work on evacuation lift proposals as part of the revision of BS 9991 (fire safety of residential building).

Various solutions for the operation of lifts for evacuation of those who are not readily able to evacuate by stairs are proposed and examined.

## 21. Remote monitoring and diagnostic for lifts

Kenneth Ong, Yih Perng Khoo, Justin Tai, Yao Hui Chee - Building and Construction Authority of Singapore

The use of Internet of Things (IoT) with remote monitoring capability or Remote Monitoring & Diagnostics (RM&D) to carry out maintenance of lifts has been gathering momentum in recent years.

The advantage of this over the traditional time-based maintenance is that it allows continuous tracking of lifts' operating condition for diagnosis of early fault detection, thus preventing unnecessary breakdowns and raising safety, reliability, and productivity levels. Recognizing the importance of these benefits, the Building and Construction Authority of Singapore (BCA) had formulated the "Code of Practice for Installation of Remote Monitoring & Diagnostics System for Lifts" which aims to provide guidelines for RM&D systems to be deployed in Singapore.

This paper will first briefly discuss the structure of the code before moving to the 2 key areas of the code: "Monitoring Outcomes" and "Performance Indicators" which aim to provide a framework on the required monitoring areas and the evaluation of the effectiveness of the RM&D system respectively. Finally, there will be a brief discussion of the results of a local RM&D trial which was based on the code.

## 22. The technical challenges involved in lifting 40 tonne trucks using rigid chain in a confined space.

Philip Pearson - Pearson Consult Ltd, UK

The paper will describe the technical challenges involved in installing two 40 Tonne truck lifts in a theatre utilising rigid chain technology (RCT) in a confined space.

It will explain how the project was procured from a consultancy perspective after the basic design of the building and lift shaft had been finalised, and on how reviewing the truck lift information, it became apparent that the design was incomplete and appeared impractical. The study will look at a number of areas including the applicable standards, anticipated loads to be lifted and evaluation of the various options for the truck lift design.

With the results and conclusions of research that was undertaken including statutory compliance, vehicle sizes and payloads, methodology of user operation expectations and requirements being discussed.

The paper will explore the technology, energy efficiency, safety of the lifting systems and comparison sites where similar operational requirements had been used resulting in the decision to recommend RCT technology. Illustrations of the challenges that were overcome during the design and installation process will be included.

## 23. Lift energy modelling for green building design

Richard Peters - Peters Research Ltd, UK

Lifts are a relatively minor concern when considering green buildings, yet increasingly they are becoming subject to scrutiny with the drive to net zero. The energy consumption of lifts is a major part of their environmental impact. To reduce that impact, first we need to improve our understanding and modelling of lift energy consumption.

Many attempts have been made to define ways of calculating lift energy consumption. Some are so simplistic that their results are of questionable value. Others are so sophisticated that their widespread application is unlikely other than to specific products.

This paper addresses why lift energy modelling is complex and discusses the factors which are most significant. Models based on calculation and traffic simulation are considered. The modelling method proposed addresses the need for considering passenger demand and allows for simple measurement and verification.

## 24. Dynamic simulations for lift health diagnosis

Gabriela Roivainen, Matti Lin - KONE Oyj, Finland

System simulations introduce new opportunities in lift health diagnosis, due to their quasi-real time computation and cross disciplines coverage. The approach is based on an object-oriented model, where controller, machinery, hoisting and building layout are interconnected for computing the lift dynamics for its entire ride.

While most of the components impacting the dynamics of lift are described by blocks with certain physical parameters, other are described more in detail, including local flexibility and eigenfrequencies expression. The created model is structured, modularized, and parametrized.

Several simulation outputs: car position, velocity and vibrations, guide shoes forces, machinery current and torque, can be used for diagnosis, however in this paper the focus is on using spectrums and spectrograms of car vibrations for this purpose.

Healthy and several malfunction behaviours are computed and validated using system simulation, proving that this approach can be used for identifying the faults and providing solutions for mitigating them.

## 25. Energy efficient buildings – Assessing the impact of lifts and escalators

Adam J Scott - Sweco UK Ltd, UK

As the impact of climate change becomes ever more visible, society appears at last to be reacting and making changes aimed at mitigating its impact and protecting our established ways of life. Most if not all of human activity affects our planet, and the creation and modernization of buildings is no exception.

The lift and escalator industry therefore has an important part to play in minimizing the impact of its activities on our climate; the creation of new lift and escalator equipment consumes energy which is quantified by its embodied carbon credentials, whilst the use of lifts and escalators consumes energy characterised by its operational carbon credentials.

These cardon credentials play a key part in the broader assessment of a building's energy performance and as an industry we now need to recognize this fact and refine both the processes and the accuracy with which we model the impact. This paper explores the current guidance and assessment methodologies touching on such established documents as the Chartered Institution of Building Services Engineers (CIBSE) TM54, and the International Standard ISO 25745. Application of these methodologies will be reviewed against a real-world case study, and conclusions and recommendations presented on how the industry might refine future assessments towards more realistic results.

## 26. The effect of artificial intelligence on service operations and service personnel

Rory Smith - University of Northampton, USA

Artificial Intelligence (AI) can significantly change service operations. The timing of when service personnel are sent to lift installations and what those technicians do when on site will change. These changes are explored.

If the service tasks performed are different, one can conclude that the skill sets of the technicians will also need to be different. The skill sets and training requirements of service technicians and service supervisory personnel are also explored.

Global urbanization, post-pandemic workplace conditions, and AI will all effect the quantity of technicians required globally. These factors and their influence on staffing are reviewed.

## 27. New evidence on lift passenger demand in high-rise office buildings

Janne Sorsa, Tiina Laine - KONE, Finland

Understanding of people flow in buildings enables proper planning of passenger lifts for a prospective building. Planning relies on design criteria for peak passenger demands, which determine the number of lifts to be installed. The design criteria should reflect either specified or expected tenant requirements as closely as possible to ensure good passenger service and user experience throughout the life cycle of the building while avoiding excessive use of core space.

Surveys on peak demands have mostly been conducted by human observers since technologies to automate passenger counting have not been commonly available. However, an automated method would enable accurate large-scale data collection and the use of data science to identify patterns in peak demands.

This paper proposes a procedure that automatically recognizes peak periods from automated passenger counts as well as provides evidence on peak passenger demands and the associated traffic mixes. To allow comparison between different measurement days and buildings, the measured demands are scaled to the actual population of lift users on the measurement day that is determined from the data.

The procedure is developed and explained by using data from a high-rise office. It is then applied to other office buildings to recognize patterns in peak demands. The results are then contrasted with the current peak demand requirements for the planning and selection of passenger lifts for a new building.

## 28. Vertical transportation design deliverance to iconic buildings

Jagadish Kumar Vimmadisetti - Lavenir Consultancy Pvt Ltd, India

Delivering a safe, healthy and sustainable built environment buildings that perform comprehensively captures the essence of a highly efficient building. This paper showcases from a vertical transportation point of view , one of the most prominent projects in India - CENTRAL VISTA located in the heart of national capital, which is a modern centre of national governance.

In any VIP building, the horizontal and vertical transportation environment becomes increasingly more important and needs to be designed in the most efficient and effective way to ensure the right balance.

In this context, the paper addresses opportunities applying new state of art technologies within a multi-disciplinary and multi-cultural environment to improve the efficiency and effectiveness of the building. The planning is done with scope for future expansion, exploring the new built typologies.

This paper finally provides a comprehensive outlook on presenting an in-depth analysis of state-of-the-art methodologies deployed for safe and smooth vertical transportation in terms of passenger comfort, code complaint, energy efficient products, sustainable maintenance procedures, IoT deployment to maximise the built potential and yet be modern and Iconic.

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# BRAKE FAILURES ON LIFTS

**DAVID A. COOPER**
LECS (UK) Ltd & University of Northampton

**Keywords:** Lift, runaway, rollback, accident, passenger safety, brake, overtravel, uncontrolled movement.

**Abstract:** Brake failures affect many types of equipment and whilst many efforts have been made in standards to improve the outcome of a brake failure they still occur. The consequences of a failure can range from a near-miss to one or more fatalities

Many service technicians take the view that with the introduction of variable frequency drives into the lift and escalator industry that the brake no longer needs maintaining. This paper will demonstrate that this opinion is incorrect.

The paper will look at what happens when a brake fails, the causes of brake failure, examples of brake failures and how recent standards have developed to reduce the risk of brake failure.

## 1. THE FUNCTION OF THE BRAKE

The function of a lift brake has changed over recent years with developments in drive systems.

Older systems such as single speed and two speed designs relied on the brake itself to bring the lift to a stop during an ordinary journey and the levelling accuracy would be dependent upon the condition of the brake pads, the load in the lift car relative to balance and the position of the lift in its shaft. With these drive systems the brake was also used to bring the lift to a safe stop in the event of a power supply fault or a control system situation (such as a high speed lock tip). The regular maintenance of the brake in this situation is vital.

Older but more sophisticated drive systems such as the DC Ward Leonard system or the DC static converter drive were designed such that the motor would bring the lift to a stop at a landing and then the brake would apply to hold the lift car for loading and unloading. Similarly these drive systems were required to bring the lift to a safe stop in the event of a power supply fault or control circuit situation previously described. Modern drive systems such as the AC VV and the variable frequency drives are similar to these however maintenance is still required as situations such as high speed lock tips can still occur and cause premature wear of brake pads.

## 2. WHAT HAPPENS WHEN A BRAKE FAILS?

A lift can be compared to a set of scales with the heaviest side of the balance equation between the car and counterweight being the side that descends when left to gravity.

In many cases when a brake fails the lift car will run upwards due to the counterweight being heavier than a lightly loaded lift car.

As the counterweight descends, where no compensation exists, the lift car ascent increases in speed as the suspension ropes pay out onto the counterweight side.

Modern lifts are fitted with uncontrolled movement devices that will detect and arrest a runaway condition such as previously described but many lifts were installed prior to this recommendation in the standards and do not have such a facility. It should be remembered that uncontrolled movement may be caused by other situations other than a brake failure.

In addition, many older lifts using single speed or two speed drive systems rely on the brake for stopping and the accuracy of the car to landing threshold is reliant on the condition of the brake, position of the lift in the shaft and the load in the car.

## 3. EXAMPLES OF BRAKE FAILURES

There are many ways that a brake can fail and these include electrically and mechanically.

### EXAMPLES INCLUDE:

1. Brake solenoid going open circuit (single solenoid)
2. Brake solenoid going open circuit (twin polarised type)
3. Physical wear of brake pad
4. Rivets coming loose on brake pad
5. Lubricant on brake pad
6. Stuck in open position – release mechanism failure
7. Stuck in open position – other mechanical failure (such as a single line component e.g. a split pin)
8. Held in open position – residual magnetism
9. System overloaded
10. Poor adjustment
11. Overheating

The failures at 1 & 2 can allow the lift to drive through the brake and if not detected early enough can lead to physical wear and ineffectiveness of the brake as at 3.

In some cases one or more of these situations can come together to create an uncontrolled movement scenario.

For instance lubricant on a brake pad plus physical wear may lead to the uncontrolled movement scenario occurring earlier than it would have done had the pad been in good order. It is, in this situation, an external influence i.e. the lubricant probably leaking from a gearbox shaft causing the failure.

Physical wear on brake pads on modern variable frequency drive lifts should not be a problem in theory but in reality uncontrolled movement has been seen when a variable frequency drive is able to drive through brake pads which is particularly prevalent when a lightly loaded lift car is in the upper reaches of the lift shaft and the suspended masses are heavier on the counterweight side.

It is difficult to cite specific cases where brake failures have occurred especially where they were the subject of legal investigations and even more so where fatal injury was sustained however there are some reports in the public domain that can be referenced [1].

There are still a number of brake release mechanisms around that can leave the brake in the open position thus allowing the lift car to move uncontrollably.

**Photograph 1 Example of a brake release that can permanently jam open**

## 4. MECHANICAL FAILURES

An early failure of a lift brake was recorded following the Markham Colliery failure on 30th July 1973 where a single line component failed. This was a significant case in that it highlighted issues around single line components and yet many years later EN81-80 (2019) 8.1 [2] acknowledges that inadequate braking systems are an issue. Interestingly the EN81-80 (2003) [3] edition did not acknowledge this.

**CONCLUSIONS**

70. I conclude that:

(i) the disaster was caused by the complete failure of the mechanical brake of the winding engine because the spring nest centre rod which was a 'single line' component, broke. The design of the trunnion did not take account of the high pressures due to the spring nest, and the main lever could not rotate freely about the trunnion axle which had no practicable means of lubrication. Consequently, operation of the brake produced bending forces and induced fluctuating stresses in the rod which it could not sustain. Cracks developed in the rod and one of them extended until failure occurred;

**Source 1 Markham Colliery Report [1]**

The requirement to eliminate single line components has been part of the philosophy of ongoing standards for many years which is looked at later in this paper.

**'Single line' components**

54. The centre rod in the spring nest is an example of a 'single line' component as the safety of the men in the cage was completely dependent upon it. Such components should either be eliminated or so designed as to prevent danger, for example, failure of any 'single line' component in a braking system should cause the winding system to be brought safely to rest. Overspeed and overwind protection should not rely on single components, but where this is not possible they should be reliable and monitored to give warning of failure, or, alternatively, they should fail safe. All winding engines which are dependent upon only one brake path should be modified as should those where automatic application of the brakes is dependent on a single solenoid. Furthermore, there should be indication of any electrical fault in a safety circuit which could render it ineffective or, alternatively, the winding engine should be automatically brought to rest if a fault occurs in a safety circuit which would give rise to danger.

**Source 2 Markham Colliery Report [1]**

An example of a single line component failure could be experienced on a typical lift brake as below and components including the plate at G being retained by a split pin, or the rod at H failing.

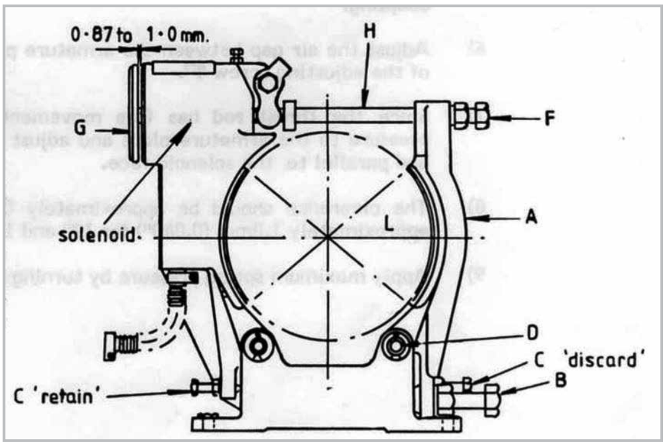
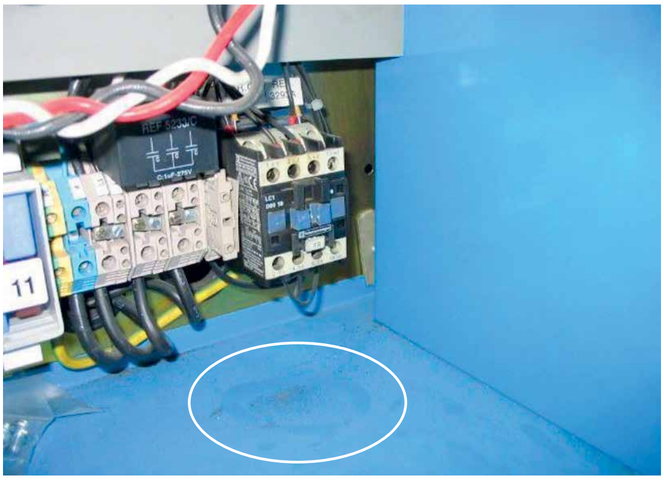



**Figure 1 Typical Old Style Lift Brake [4]**

## 5. ELECTRICAL FAILURES

Electrical failures, including the single solenoid going open circuit in the diagram above could result in a brake failure but other contributory factors could be present including high resistance on brake contactors meaning that the brake only lifts partially making it easy for a variable drive system to drive through the brake thus accelerating wear until eventual failure and lift car uncontrolled movement (runaway) occurs.

The photograph below shows a brake contactor that was involved in an uncontrolled movement incident as a result of the brake contactor not having been replaced in a timely fashion. The lift industry more often than not waits for something to fail as the impulse to initiating component replacement [5].



**Photograph 2 Build up of carbon dust under the brake contactor indicating oncoming problems.**

In another industry technical information notice [6] thermal fuses were fitted to lifts where the brake shoe temperature became excessive.

4. **Field Solution:**

To fit thermal fuses to the brake shoes that will trip when the brake shoe temperature exceeds 71 C. This will render the lift out of service when it reaches its destination. The lift will be unable to go back into service until the thermal fuse is replaced before which the cause of the overheating should be investigated and rectified

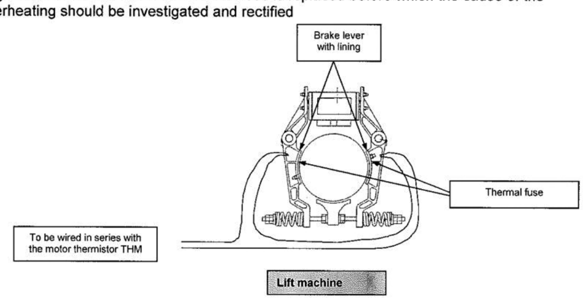



**Figure 2 Industry manufacturers technical information sheet [6]**

## 6. DEVELOPMENT OF STANDARDS

Over the years there have been many improvements in braking systems for lifts including the introduction of the A3 amendment for uncontrolled movement however this dealt with the symptom of brake failure rather than the cause.

The current edition of EN81-20 [7] includes uncontrolled movement detection and also the requirement for brake components to be in two sets this offering redundancy and monitoring of the brake itself for correct operation.

**5.6.7.2** The means shall detect unintended movement of the car, shall cause the car to stop, and keep it stopped.

**5.6.7.3** The means shall be capable of performing as required without assistance from any lift component that, during normal operation, controls the speed or retardation, stops the car or keeps it stopped, unless there is built-in redundancy and correct operation is self-monitored.

**5.9.2.2.2.1** This brake on its own shall be capable of stopping the machine when the car is travelling downward at rated speed and with the rated load plus 25 %. In these conditions the average retardation of the car shall not exceed that resulting from operation of the safety gear or stopping on the buffer.

All the mechanical components of the brake which take part in the application of the braking action on the braking surface shall be installed at least in two sets. If one of the brake sets is not working due to failure of a component a sufficient braking effort to decelerate, stop and hold the car, travelling downwards at rated speed and with rated load in the car and upward with empty car shall continue to be exercised.

As has already been mentioned the EN81-80 (2003) [3] standard didn't mention inadequate braking systems however the 2019 version [2] has been expanded to include this situation.

## 7. CONCLUSIONS

The author is of the opinion that:

- Older lifts with single line components in the braking system need to be assessed.
- All brakes should be fitted with lift detection switches.
- Where modernisation takes place and an old style brake is retained and a variable frequency drive is fitted to replace an older system such as single speed, two speed etc there is a real risk that the lift can drive through a closed brake.
- Prevention is better than cure and methods of detecting the depletion of braking efficiency should be developed so as to detect rather than respond to a failure situation. The potential for uncontrolled movement should be detected before it actually happens.
- Checking of brake condition and adjustment is still an essential part of the maintenance regime as extraneous situations such as high speed lock tipping can affect braking performance.

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[4] BEI, Technical information sheet (DNK)

[5] Cooper, D. How many failures are enough? LES

[6] OTIS, Technical information sheet (DNK)

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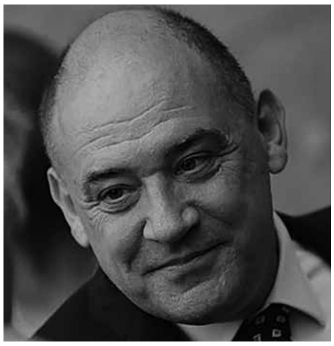

David Cooper is the Managing Director of UK based lift consultants LECS (UK) Ltd.

He has been in the lift & escalator industry since 1980 and is a well-known author and speaker. He holds a Master of Philosophy Degree following a 5-year research project into accidents on escalators, a Master of Science Degree in Lift Engineering as well as a Bachelor of Science Honours degree, Higher National Certificate and a Continuing Education Certificate in lift and escalator engineering.

He is a co-author of "The Elevator & Escalator Micropedia" (1997) and "Elevator & Escalator Accident Investigation & Litigation". (2002 & 2005) as well as being a contributor to a number of other books including CIBSE Guide D. He is a regular columnist in trade journals worldwide including Elevation, Elevator World and Elevatori.

He has presented at a number of industry seminars worldwide including 2008 Elevcon (Thessaloniki), 2008 NAVTP (San Francisco),1999 LESA (Melbourne), 1999 CIBSE (Hong Kong), 1999 IAEE (London), 1998 (Zurich), 1997 CIBSE (Hong Kong), 1996 (Barcelona) and 1993 (Vienna) as well as numerous presentations within the UK.

He is also a Founding Trustee of the UK's Lift Industry Charity which assists industry members and/or their families after an accident at work. In 2012 David was awarded the silver medal by CIBSE for services to the Institution.

David Chairs the Charitable Trust that runs the Lift Symposium and is an Honorary Visiting Professor in Lift Engineering at The University of Northampton.

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# THE TWO MODES OF FAILURE OF ESCALATOR BRAKING SYSTEMS

**LUTFI AL-SHARIF[1,2]**
[1]The School of Engineering Technology, Al-Hussein Technical University, Amman, Jordan

[2]Mechatronics Engineering Department, The University of Jordan, Amman 11942, Jordan

**Keywords:** escalator braking systems, runaway condition, escalator kinematics, passenger falls, intelligent braking systems deceleration, jerk.

**Abstract:** The braking system in an escalator is the most critical safety component. Failure of the escalator braking system can lead to passenger injury and even fatalities. Escalator braking systems can fail in two modes: In the first mode of failure, the braking system fails to arrest the descending load and slow it down when it is not correctly adjusted or completely out of adjustment. This leads to a runaway situation. The second mode of failure is when the escalator braking system is too tightly adjusted such that it leads to a severe stop of the escalator and consequential passenger falls. Passenger falls on escalators are one of the major causes of accidents including cuts, bruises, finger entrapment and in certain cases crushing leading to suffocation. The paper provides an overview of these two types of failures, their causes and possible solutions. One of the technical solutions previewed is the use of intelligent escalator braking systems in order to control the deceleration of a stopping escalator. Two technologies exist for control the escalator braking systems: electrical and hydraulic.

## 1. INTRODUCTION

The braking system in an escalator is the most critical component. Failure of the braking system on an escalator can lead to passenger injuries and even fatalities.

This paper attempts to review the failure of the braking system that leads to passenger injuries. There are two modes of failure for escalator braking systems. The first mode of failure of the braking system is when it fails to slowdown and stop the loaded escalator. This leads to a dangerous increase in speed and the consequential passenger injuries caused by the formation of a 'human pile' at the lower landing of the escalator. The second mode of failure of the escalator braking system is when the braking system applies too harshly when it is lightly loaded, causing passenger to lose balance and fall, with consequential injuries in the form of cuts, bruises and even finger entrapments.

It could be argued that these two types of failures are not failures in the classical sense of the work (e.g., a classical failure is when a component is damaged, or a sensor is not sending a signal). While this is true, these two failures are basically forms of maladjustment leading the inability of the braking system to perform its function. Hence, they have been classified as failures in this paper.

It is worth noting that the first mode of failure is easily reversible if detected in good time. It is also worth noting that there are other failure modes in the escalator that are irreversible. A better understanding of the contents of this paper can be gained by understanding the status of safety regulations for major escalators in the world.

This paper reviews the research and practical work carried out to date in all the areas above. The paper provides some necessary background information about escalator braking in terms of the passenger accident causation model (section 2), the anatomy of an escalator stop (section 3), the standard requirements regarding escalator braking system performance (section 4) and the requirement for weight testing in public service escalators (section 5).

The problem of escalator runaway accidents is reviewed in section 6 including suggested new methodology for testing the escalator braking system without the use of weight to avoid this failure mode. Section 7 examines the experimental work done in finding a relationship between the kinematics and mechanics of the stopping escalator and the risk of passengers falls. The work done in this area provides a recommended value for the maximum value of deceleration that should not be exceeded during an escalator stop. Section 8 reviews two types of intelligent braking system that are used to prevent the deceleration of the stopping escalator exceeding these recommended values: hydraulic braking systems and electrical braking systems. Conclusions are drawn in section 9.

## 2. THE ESCALATOR PASSENGER ACCIDENT CAUSATION MODEL

It is useful at this stage to discuss the passenger causation model in escalators. Previous research has identified three categories that lead to passenger accidents on escalators [1]:

### EXAMPLES INCLUDE:

1. Design: During the design phase of the escalator braking system, the risk of brake failure can be reduced or eliminated.
2. Inspection and maintenance: Inspection is critical in identifying problems in the braking system early on and addressing them via maintenance.
3. Passenger behaviour: Passenger awareness is important in avoiding accidents. Good awareness could avoid the risk of passenger falls (e.g., holding onto the handrail and facing the direction of travel).

This model provides a guidance framework for the prevention of passenger accidents (Figure 1). By analysing the three categories above (or a combination thereof), it is possible to identify the root causes of an accident and prevent it. More on passenger accidents on escalators can be found in [2] and [3].

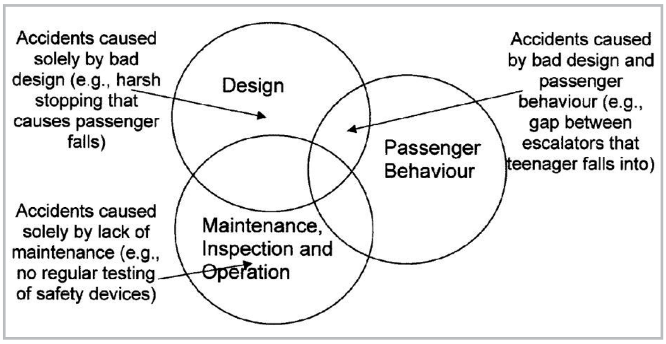


**Figure 1 Venn Diagram of Escalator Accidents Causation [1]**

## 3. ANATOMY OF AN ESCALATOR STOP UNDER THE INFLUENCE OF THE BRAKING SYSTEM

Another useful tool that can be essential in understanding brake operation and thus brake failure is the speed-time profile of the escalator step-band during a stop. The speed-time profile is a plot of the speed of the step-band of the escalator against time.

Figure 2 shows the speed-time profiles for a public service escalator. The braking systems comprises two parts: An operational brake and an auxiliary brake (using EN 115-1:2008 terminology). Both brakes are hydraulically lifted and spring-applied (for obvious safety reasons).

As can be seen, the stopping time (from the time that the stop-switch is pressed until the escalator comes to a complete standstill) is around 2 seconds. This stopping time includes the electrical delay (around 350 ms), the mechanical delay (around 360 ms), the brake torque build-up (around 890 ms), and the final stopping time under full brake torque (around 400 ms).

The figure also shows the comparison with a frictional stop (where the escalator stops under the effect of friction only without any braking torque). This is useful for providing an indication of the mechanical status of the step-band.

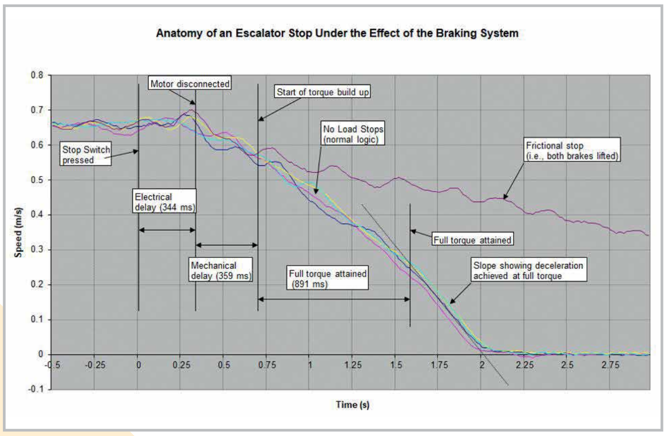

**Figure 2 The speed-time profiles for a public service escalator under the influence of the braking system**

## 4. BRAKE PERFORMANCE REQUIREMENTS

The brake performance requirements as set out in the European Standard EN115 only stipulate maximum and minimum stopping distance. The maximum stopping distance relate to the fully loaded escalator running in the down direction. The minimum stopping distance relates to empty stopping escalator (see Table 1).

The rationale for this is that the escalator should not stop too abruptly when empty, so that it does not cause passenger falls when passengers are travelling on it. When fully loaded it should be able to stop within a reasonable distance to protect passengers from a runaway situation.

**Table 1 Stopping distance in accordance with EN115.**

| Rated speed | Stopping distance |
|---|---|
| 0.50 m/s | min. 0.20 m; max. 1.00 m |
| 0.65 m/s | min. 0.30 m; max. 1.30 m |
| 0.75 m/s | min. 0.35 m; max. 1.50 m |

The American Standard (ASME A17.1-2010/CSA B44-10) specifies the maximum value of deceleration of the escalator, as 0.91 m/s2.

The stopping distance on its own is a poor indicator of brake performance. Based on several pieces of research, there is strong evidence to suggest that the maximum value of deceleration is the best indicator of the passenger stopping comfort and the risk of passenger falls [4]. It is believed that the maximum value of the deceleration during an escalator stop is inversely proportional to the risk of passenger falls. EN115 has been re-drafted to specify an additional maximum deceleration requirement of 1 m/s2 in addition to the stopping distances.

## 5. WEIGHT TESTING REQUIREMENTS ON PUBLIC SERVICE ESCALATORS

Prior to discussing the mode of failure where the braking system fails to slowdown the loaded escalator and bring it to standstill, it is useful to look at the weight testing that is carried out on public service escalators to mitigate the risk of such a failure.

The function or the braking system on the escalator is to ensure that the fully loaded escalator is brought safely to a standstill when required to do so following the tripping of a safety device or the activation of the passenger emergency stop switch. Recent developments have introduced the use of electrical braking systems to complement the mechanical braking systems [5].

It is generally a requirement that full load weight testing be carried out for new, refurbished and partially refurbished escalators to prove that the braking system is capable of (and has been set up to) arresting the fully loaded escalator running in the down direction at rated speed and bringing it to a standstill within the distances stipulated by EN115-1:2008.

Weight testing is a very lengthy and costly process. It is carried out when an escalator has been replaced or refurbished or where the braking system has been altered. This is especially critical on public service escalators. Public service escalators are subjected to high level of passenger traffic which makes the safety of the brakes even more critical.

A value of 150 kg per step is generally assumed in order to calculate the motor or inverter size for public service escalators. The 150 kg is equivalent to two passengers per step each weighing 75 kg, and is over and above the requirement of EN115-1: 2008

Much research has been carried out on the energy drawn by escalators [6] that have shown that that the power drawn by an escalator in kW can be calculated as follows (and is central to the weightless weight testing methodology that is discussed later in this section: by finding the no load power drawn by the escalator, it then becomes possible to find the frictional torque in the escalator):

$$P_{NL} = 0.47 \cdot r + 1.74$$

Where: $P_{NL}$ is the power drawn by the escalator at rated speed and no load in kW $r$ is the escalator rise in m

A previous paper [7] presented a measurement-based-model that allows the prediction of the stopping distance of an escalator under loaded conditions in order to obviate the need for the full load weight testing. Such a model will enhance the level of safety in escalators and allow a more scientific approach to the subject of weight testing and proofing of the brakes.

If the relationship between the steady-state speed, deceleration, and stopping distance is clarified under the regulatory standards, physical information that leads to the status of accident countermeasures can be obtained.

## 6. RUNAWAY CONDITIONS ON ESCALATORS

Runaway situations are one main source of serious passenger injuries on escalators. A runaway situation takes place when a heavily loaded escalator accelerates downwards exceeding its rated speed and causing a passenger pile at the lower landing. An example of a runaway situation was the accident at the CN Tower in Toronto that took place in 1988. The following is an excerpt from the news item in the press (shown from Elevator World December 1988 below):

*"Nine children were taken to the hospital after being in a human pile-up on an escalator at the base of Toronto's CN Tower, but were quickly released. Staff-Sergeant Doug Ecklund of the Metro Police said witnesses reported that the escalator seemed to accelerate before halting after the emergency stop button was pushed. He said an adult pushed the button after becoming concerned about congestion at the base of the escalator."*

Runaway situations take place when the braking system of the escalator is not properly adjusted and cannot bring the loaded escalator to rest. When the escalator stops unloaded or lightly loaded, the friction in the escalator is sufficient to stop it. However, when the escalator is heavily loaded with passengers (as is the case during rush hours or following major events such as football matches or concerts) the braking system is unable to stop the loaded escalator when the stop button is pressed. Passengers are reported as saying: "I pressed the stop switch a number of times, but the escalator did not stop!" Tests carried out after the accident do not reveal the problem, as the escalator is stopped with no load on it, and friction is sufficient to bring it to rest.

What happens during a runaway situation is outlined here. A down-moving heavily loaded escalator is given a command to stop (either by someone pressing the stop switch or by a spurious safety device trip). The motor is then disconnected from the source of supply by the tripping of the main contactors.

By taking the power away from the motor, the escalator is left to move freely under gravity. As the braking system is ineffective the escalator and its load start accelerating downwards. Attempts by passengers to stop it by pressing the stop switch are futile, as the escalator is already 'electrically' stopped; and is in fact mechanically under gravity. The escalator accelerates to dangerously high speeds (speeds as high as 2 m/s have been reported). Passengers get to the lower landing falling on each other and forming a 'human pile'. Once a significant number of passengers have been 'thrown' off the escalator, the escalator starts slowing down until it stops under friction.

In cases where the heavily loaded escalator is moving upwards, the escalator slows down to a standstill and then reverses direction and accelerates downwards in the same sequence of events discussed above for the case of the down moving escalator.

In certain cases, the cause of the runaway is not a defective braking system, but a mechanical shearing of the top shaft of the escalator. The sequence of events however is similar.

If the problem is not detected by operational staff, what happens sometimes is that the escalator is left in service (in a stationary condition) following the accident. New passengers arriving find the escalator stationary and think that it is in service as a fixed staircase. Once sufficient passengers have boarded the stationary defective escalator it starts moving downwards under gravity, repeating the sequence of events above.

The following are examples of runaway incidents:

- Toronto CN Tower, December 1988 (down).
- MARTA (Metropolitan Atlanta, Rapid Transit Authority), Atlanta, Georgia, U.S.A. Escalators locked off to prevent free-wheeling during crowded conditions (Elevator World 1997).
- London Underground, London, United Kingdom, Oxford Circus Station, Escalator number 4, August 1999 (sheared top shaft).
- 18th January 2000, Nashville International Airport, U.S.A.
- Newcastle, England, United Kingdom, Metro escalator, May 1st, 2001 (up).
- Newcastle, England, United Kingdom. Metro escalator, February 9th 2002 (down).

- London Underground, London, United Kingdom, Waterloo Station, 2002.
- Anaheim, California, baseball fans May 7th 2002, 15 passengers with minor injuries (down).
- Coors Field Stadium (Denver, Colorado, U.S.A.) 9/7/2003, 20 injured.
- Raffles City Shopping Centre, Singapore, May 2003, (up), 1 person hospitalised.
- Escalator reversed direction, Xinzhuang Station, Shanghai, China, number one subway line, 38 people injured (up).

A recent paper by David Cooper more comprehensively covers this type of failure [8]. The current status of risk control for escalators can be grasped by describing the diffusion rate of safety measures after the revision of EN115-1:2008.

## 7. RESEARCH INTO THE EFFECT OF THE KINEMATICS OF A STOP ON PASSENGER FALLS

The other mode of failure is the escalator stopping harshly when lightly loaded and causing passengers to fall. Passenger falls on escalators can be caused by escalator stops. It has been shown that 2.5% escalator unplanned stops can lead to passenger falls. Passenger falls on escalators can lead to a range of injuries, starting from cuts and bruises upon impacting the steps, finger entrapment between the steps and the skirts and as severe as crushing at the lower landing due to other passengers falling on each other with the risk of suffocation [9].

Three studies have been carried out into the relationship between the risk of passenger falls on a stopping escalator and the kinematics of the stop. The methodology is based on asking volunteers to assess the quality of the stop either in words [4] and [10] or on a numeric scale from 1 to 10 [11].

The work in [4] and [11] concludes that a value of 1 m·s-2 for the value of acceleration during an escalator stop seems to be a reasonable limit to impose on the maximum value of acceleration during a stop.

This method is based on the use of human subjects who would ride the escalators during the stop and provide a subjective assessment of the quality of the stop and their assessment of the risk of falling. An example of this empirical approach can be found in [10] where experimental tests on subjects were used to find their perception threshold of movement in relation to age and other factors.

### THE RESEARCH IN THIS AREA CAN BE SUMMARISED AS FOLLOWS:

1. General research on the risk of passenger falls [12, 13, 14].
2. The qualitative relationship between passenger falls and the kinematics of a stop [11, 4, 10].
3. The quantitative relationship between passenger falls and the kinematics of as stop using analytical models [15].

### THE OUTCOME OF ALL THESE PIECES OF RESEARCH (BOTH QUANTITATIVE AND QUALITATIVE) SHOWS THAT:

1. The most important factor in causing passenger falls during an escalator stop is the maximum value of the deceleration.
2. Placing an upper limit on the value of deceleration of a stopping escalator of 1 m/s2 would ensure that most passenger falls caused by the escalator stop are eliminated.

This value would be the recommended target design and testing value that would be used as a testing criterion for the acceptability or otherwise of the performance of the escalator braking system. Such a criterion would eliminate the risk of passenger falls caused by the escalator unplanned stoppage. The next section discusses how the use of intelligent braking systems is applied in achieving this requirement.

## INTELLIGENT BRAKING SYSTEMS

As discussed in the earlier sections, a limit must be placed on the maximum value of the acceleration of a stopping escalator in order to ensure that passenger falls are avoided when a lightly loaded escalator stops (especially in response to a safety device tripping or a manually operated stop switch).

The maximum allowable value of the deceleration of the stopping escalator can be used as the control variable in the intelligent braking system. An intelligent braking system is a system that controls the stopping speed profile of the escalator in order to achieve the required stopping distance or speed. A block diagram of a generic intelligent braking system is shown in Figure 3 below.

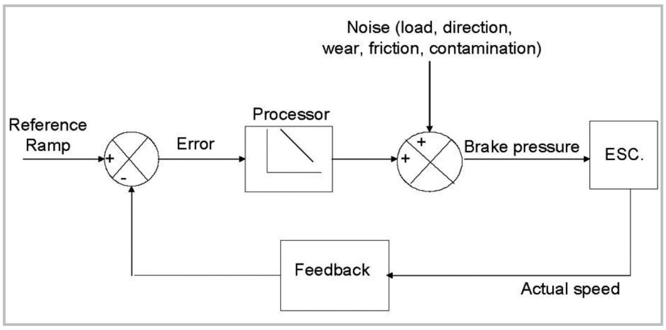


**Figure 3 Block diagram of an intelligent braking system (with a negative feedback loop)**

It is now possible with the use of modern escalator braking systems (electrically or hydraulically based intelligent braking system) to continuously monitor the value of speed and acceleration of the escalator in real time and adjust the electrical braking effort in order to avoid the deceleration exceeding the target value. This is outlined in detail in [5] and [16].

**Hydraulically based systems:** Hydraulically based systems require that one of the conventional brakes be hydraulically lifted. Hydraulic systems control the hydraulic pressure lifting the brake pads off the disk. This can either be done by the use of a linearly proportional valve or using on/off modulation by varying the duty ratio (i.e., on/off ratio). Hydraulically based intelligent braking systems are discussed in more detail in [16].

**Electrically based systems:** Modern escalator control systems are equipped with variable speed drives that are used for starting the escalator and running it at different speeds during the day. This drive can also be used to implement the intelligent braking function. Electrically based systems employ the variable speed drive (usually a VF drive) to bring the escalator to a standstill and then apply the mechanical brakes as holding devices. In this case the mechanical brakes that are used for conventional braking become merely parking brakes applied once the escalator has come to a standstill. The inverter used on this system does not employ closed loop feedback and it relies on the fact that the motor will follow the speed that is set by the frequency sent by the drive.

An example of the performance of an electrically based intelligent braking system is shown in Figure 4. It is clear from the figure how the braking system achieves the same deceleration regardless of the load on the escalator [5].

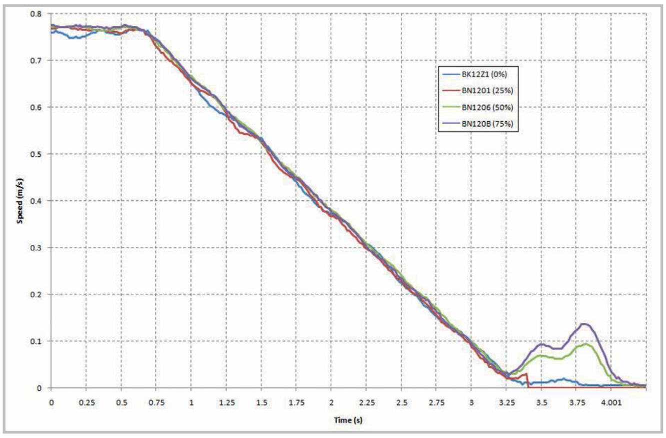


**Figure 4 Graph showing the speed-time profile of the stopping escalator under the influence of the variable speed drive under 3 loading scenarios.**

Generally, the electrically based intelligent braking system is now becoming more widely used compared to the hydraulically based systems.

### A COMPARISON IS SHOWN BELOW:

1. The electrical braking system is generally found to be faster in responding to the changes in the speed of the escalator, and thus achieves a much closer control on the speed profile.

2. In general, the cost of the electrical braking system is lower than the hydraulically braking system as many of the modern escalators already contain a variable speed drive. In order to implement a hydraulic based intelligent braking system, a special controller is needed as well as a pulse width modulation (PWM) feature in order to control the operational brake valve.

3. The implementation of the electrical braking system contravened older version of the EN115, but this has now been addressed in the latest revision of EN115-1:2008.

### CONCLUSIONS

There are two modes of failure of escalator braking systems. The first mode of failure is when the escalator braking system is badly adjusted or worn, that is fails to slowdown and stop a fully loaded escalator. This can lead to serious passenger injuries (e.g., suffocation) where the downward speed of the escalator significantly exceeds the rated speed of the escalator. This risk of failure is mainly prevented by regular inspection and maintenance. To avoid the need for weight testing on public service escalators, modern modelling techniques can be used to predict the performance of a fully loaded escalator from deceleration measurements on unloaded escalators.

The second mode of failure is when the braking system causes a harsh stop for the lightly loaded escalator, such that is causes passenger falls. Passenger fall can cause a number of injuries such as cuts, bruises and even finger entrapments between the step side and the skirting.

It is worth noting that the first mode of failure is easily reversible if detected in good time. It is also worth noting that there are other failure modes in the escalator that are irreversible.

Research has been carried out into the relationship between risk of passenger falls and the kinematics of the stop. It has been found that there is strong correlation between the deceleration of the stopping escalator and the risk of passenger falls. Kinematic modelling has also found that a restriction of 1 m/s2 must be placed on the value of the deceleration of a stopping escalator to prevent passenger falls on a stopping escalator. This value of deceleration can be used in intelligent braking systems.

Intelligent braking systems can be used on escalators in order to control the stopping distance and speed of an escalator, regardless of the fluctuations in the load on the escalator and the direction of travel. Two types of such systems can be used: electrically based and hydraulically based. The electrically based system uses the variable speed drive that is part of the electrical control system of the escalator. The hydraulically based system employs an operational brake hydraulic system with a pulse width modulated valve. The electrically based system has been used with good results and shows accurate control of the stopping speed profile regardless of the load.

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N.B. Reference has been made to the older EN115 standard 2008, rather than the latest standard 2017.

## BIOGRAPHICAL DETAILS

Lutfi Al-Sharif is currently the Dean of Engineering Technology and Professor of Electrical Engineering at Al-Hussein Technical University in Amman/Jordan and jointly Professor of Building Transportation Systems at of the Department of Mechatronics Engineering, The University of Jordan.

He received his Ph.D. in elevator traffic analysis in 1992 from the University of Manchester, U.K. He worked for 10 years for London Underground, London, United Kingdom in the area of elevators and escalators.

He has over 50 papers published in peer reviewed journals and conferences in the area of vertical transportation systems and is co-inventor of four patents and co-author of the 2nd edition of the Elevator Traffic Handbook, and the author of the "indoor transportation" chapter in the Elsevier Encyclopaedia of Transportation.

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# THE IMPLICATIONS OF THE LIFTING OPERATIONS AND LIFTING EQUIPMENT REGULATIONS (LOLER) 1998 IN CARE HOMES

**LAURA SMITH**
Senior Environmental Health Officer (BSc Environmental Health) Oldham Council, UK/University of Salford, UK, ***laura.smith@oldham.gov.uk***

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**This research was completed in 2014 as part of fulfilling the MSc in Occupational Safety and Health at the University of Salford.**

**Abstract:** Recent health and safety work by Environmental Health Officers from a North West Local authority has identified problems in relation to compliance with the thorough examination requirements of LOLER. The problem was particularly identified after health and safety audits in a number of sectors where lifting equipment is regularly used.
When Officers asked for evidence of lift certification, a large proportion of the certification produced clearly did not comply with the requirements of LOLER, despite the examination certificate in some instances looking very similar to a 'thorough examination' and despite the fact that the duty holder believed that they had complied.

This research project particularly focused on the implications of LOLER within Care Homes.

The overall aim of the project was to gain a further more detailed picture of what compliance levels are in care homes, in relation to 'thorough examination' of lifting equipment. Furthermore the aim was to determine if 'duty holders' within the residential care home setting, have sufficient knowledge and understanding of the requirements of LOLER in relation to thorough examination of lifting equipment in order to achieve compliance.

Overall the research found that compliance levels in relation to 'thorough examination' of lifting equipment within care homes was weak. In short the majority of sample 'thorough examination' reports returned as part of the research did not fully comply with the Regulations. Also although respondents in the main seem to have some understanding of the Regulations, further work must be done to ensure that awareness and understanding is improved.

A main recommendation is to the Health and Safety Executive (HSE) and local authorities, recommending that they focus a campaign on raising awareness of LOLER and the thorough examination requirement with duty holders.

## 1. INTRODUCTION

Every year, there are many accidents to employees and service users from using work equipment in health and social care, for example, in relation to the use of hoisting equipment, the HSE reported that 163 hoisting accidents were reported to them under the Reporting of Injuries Diseases and Dangerous Occurrence Regulations (RIDDOR), between April 2001 and December 2007 [1].

They report that falls from hoisting equipment can occur for a variety of reasons including the selection of the wrong sling resulting in the risk of the person slipping through it, to failure of equipment due to poor maintenance. Ensuring that work equipment is well maintained is therefore an essential factor in reducing the risk of such accidents.

The Lifting Operations and Lifting Equipment Regulations (LOLER) were introduced in 1998 and impose duties on 'duty holders' in relation to the provision and use of lifting equipment and in particular it imposes duties in relation to thorough examination and inspection of lifting equipment.

Within Care Homes, numerous pieces of lifting equipment are used and fall under the scope of LOLER, including lifting hoists, stand aids, slings, bath hoists, lifting platforms and stair lifts.

Other equipment such as reclining chairs and profiling beds are not within the scope of LOLER, however requirements under the Provision and Use of Work Equipment Regulations (PUWER) 1998, to adequately maintain the equipment still apply.

Recent work by the Environmental Health department at a North West Local Authority has identified problems in relation to compliance with the thorough examination requirements of LOLER. It has been identified in a number of sectors where lifting equipment is regularly used, such a tyre and exhaust premises, car sales premises, warehouses and within the residential care sector, that some duty holders are confusing 'general maintenance/ servicing' with thorough examination. It has also been identified that some certification provided by lift companies, although it looks to be a thorough examination report, actually doesn't comply with the requirements of LOLER.

This project focused on compliance, knowledge and understanding within the care sector so that findings and practices within the same sector could be bench marked against one another. Additionally the implications of non-compliance with LOLER for this sector are arguably greater, considering the vulnerability of the users of lifting equipment within this sector.

The overall aim of this research project was to gain a further more detailed picture of what compliance levels are in Care Homes, in relation to thorough examination of lifting equipment (as required under LOLER). Furthermore the aim was to determine if 'duty holders' within the Residential Care Home setting, have sufficient knowledge and understanding of the requirements of LOLER in relation to thorough examination of lifting equipment in order to achieve compliance.

## 2. REVIEW OF LITERATURE

LOLER came into force in 1998 and replaced most of a range of sector based legislation on lifting equipment e.g. legislation on factories, offices, shops, railway premises and construction sites [2]. A specific requirement of LOLER is that lifting equipment must be 'thoroughly examined'. The requirement to thoroughly examine actually dates back to the introduction of steam power in factories, when there was a great number of explosions of steam boilers and it was discovered that a legal requirement to have the boilers regularly examined by a competent person did dramatically reduce the number of such incidents [3].

### 2.1. WHAT IS LIFTING EQUIPMENT?

Under LOLER (Regulation 2) lifting equipment is defined as 'work equipment for lifting or lowering loads and includes its attachments used for anchoring, fixing or supporting it'. An accessory for lifting is defined as 'work equipment for attaching loads to machinery for lifting'. Examples of the types of lifting equipment and operations covered under the Regulations include; a passenger lift in an office block, a rope and pulley used to raise a bucket of cement on a building site, a bath hoist for lifting a resident into a bath in a nursing/care home, or, a refuse vehicle loading arm used for tipping. [4].

The Regulations apply to both employers and the self-employed who provide lifting equipment for use at work, or to persons who have control of the use of lifting equipment however they do not apply to lifting equipment to be used primarily by members of the public, for example lifts in a shopping centre [5]. The fact that equipment is designed to lift and lower a load doesn't necessarily mean that LOLER applies [6]. The equipment must be defined as 'work equipment' which is defined under PUWER 1998.

### 2.2. THOROUGH EXAMINATIONS, INSPECTION AND MAINTENANCE

In particular LOLER sets out detailed requirements in relation to the thorough examination of lifting equipment. A 'thorough examination' is defined by the HSE as a 'systematic and detailed examination of the lift and all its associated equipment by a competent person' [7] and its aim is to detect any defects which are, or might, become a danger to persons and for the competent persons to report such defect to the relevant persons.

Regulation 9 outlines requirements in relation to how often lifting equipment and accessories must be thoroughly examined.

Additionally under the Regulations, it may be that lifting equipment may need to be 'inspected' by a competent person, between thorough examinations. The Approved Code of practice for LOLER [4] indicates that a suitable inspection should be carried out where a risk assessment has identified a significant risk to operators or other workers from the use of the lifting equipment. It indicates that inspections must be undertaken by a 'competent person' and that frequency and extent of the inspections required will depend on the potential risk from the equipment.

Routine maintenance is not the same as thorough examination and inspection and typically involves checking and replacing worn or damaged parts, topping up fluid levels, lubricating and making routine adjustments

[8]. Maintenance is a requirement under Regulation 5 of PUWER 1998. Preventative maintenance is best used in order to preserve the operational integrity of the installation [10]. Ensuring that lifting equipment is routinely maintained can be cost effective for a duty holder, as it will ensure that equipment continues to operate as intended, and risks associated with wear or tear are avoided.

### 2.3. CONFUSION?

It has been reported that businesses generally had demonstrated a sound working knowledge of LOLER, however a number of business organisations have revealed limited knowledge of the requirements under LOLER, in particular small to medium sized businesses [10]. In research prepared for the HSE, [2] it was found that many were confused about the meaning of the terms 'inspection', 'thorough examination' and 'maintenance', including both equipment suppliers and duty holders. For example one equipment supplier within the research study explained how they found it hard grasping the difference between 'inspection' and 'maintenance'. The equipment supplier explained how they were still doing presentations 4 years on for their clients (from the introduction of the Regulations), stating that there is 'confusion and ignorance'. In another study it was reported that an area where additional advice was often sought from trade associations was in relation to the distinction between inspections and thorough examinations with one respondent in his study reporting '..there's an awful lot of confusion in the industry between thorough examination, inspection, and sort of the meaning of both' [10].

### 2.4. COMPETENT PERSON

As discussed, LOLER requires that the person undertaking a thorough examination and inspection of lifting equipment be a 'competent person'. The term 'competent person' is not defined in law, however the HSE's Approved code of Practice and Guidance document for LOLER defines the term competent person and states that a competent person should have such appropriate practical and theoretical knowledge and experience of the lifting equipment to be thoroughly examined as will enable them to detect defects or weaknesses and to assess their importance in relation to the safety and continued use of the lifting equipment.

This Approved Code of Practice also states that the competent person must be 'sufficiently independent and impartial to allow objective decisions to be made'. The guidance explains that a competent person can be a member of their own organisation who has the necessary competence and need not necessarily be employed from an external agency. It indicates however that they must ensure they have the 'genuine authority and independence to ensure that examinations are properly carried out and that the necessary recommendations arising from them are made without fear or favour'. Interestingly it has been found that almost one half of users and over a third of suppliers (of lifting equipment) believed that inspection is always externally provided and formally reported [2].

This research concluded that if this is considered along those who see inspection as anything that involves checking health and safety features (over 60 %) one can see that this might well be seen as an onerous requirement and may explain why some are resistant to carry out inspection. Interestingly they highlight that this may add to people's opinions about the unnecessary bureaucracy of health and safety regulation.

### 2.5. TURN OFF OR LEAVE ON?

Interestingly, there have been some concerns raised by some authors about the actions of individuals undertaking thorough examinations. Following the identification of any defects which are or could become a danger to persons, during a thorough examination, LOLER, Regulation 10 indicates that the person making the examination should 'notify the employer forthwith'. A recent health and safety prosecution by the City of London Corporation, heard in July 2012, involved prosecution of a property management company, after statutory thorough examinations of two passenger lifts uncovered defects which required immediate attention. The engineer conducting the examination subsequently left a notice on site describing the defects and the timescale for repair. The management company acted upon the report the next day by arranging for repairs to be carried out but left the lifts still in use. Prohibition Notices were subsequently served by an Environmental Health Officer and consequently a prosecution was brought against the company [11]. The case has created debates amongst professionals within the lift industry. Cooper [12] following a recent meeting amongst fellow professionals indicated that the room was divided in opinion as to whether or not an engineer surveyor undertaking a LOLER examination under Regulation 9 should switch a lift off if an 'immediate' defect is identified. He indicates that he is of the opinion that this isn't a LOLER argument and sees it as a Health and Safety at Work Etc. Act one, in that the Act imposes duties on us all and if anyone identifies a dangerous defect that presents an imminent danger of death or injury to anyone he feels 'the decision is simple. Make safe and isolate'. Gilbert [13] writes similar opinions. He highlights that those conducting a thorough examination are relied upon by their client to provide appropriate information and advice about the potential danger from any defect. He questions however why it is that someone recognised as a competent person, can just walk out of a building leaving lifting equipment in operation, when they have just deemed it to be unsafe? What is interesting to note is that LOLER clearly place this duty on the employer/duty holder and not the competent person.

As discussed above, the term 'competent' person, is not defined in law, and although the term is defined in the Approved Code of Practice, there is no current 'database' of 'competent persons'. This is in contrast to for example the regulation of gas engineers. Under the Gas Safety (Installation and Use) Regulations 1998 for a gas engineering business to lawfully undertake gas work that is within the scope of the Regulations, they must be on the Gas Safe Register. It is clear that illegal gas work by unregistered engineers is taken seriously as can be seen by recent prosecutions brought by the HSE (e.g. see [14]). It could be said that such serious action being taken by the HSE will act as a deterrent to others from working on gas equipment illegally. In terms of the competency of persons working on lifting equipment however, no such 'register' exists. Organisations can become members of associations such as the SAFed as a method of proving their competency to their clients, however this is not a legislative requirement. What is however clear is that the HSE and local authorities will take action against duty holders for failing to maintain lifting equipment and have equipment thoroughly examined (see [15]).

Interestingly is has been reported that 'competent person' is not a well understood phrase, with many suppliers and hirers (of lifting equipment) believing that their customers do not understand what competence means [2]. A suggested reason for this was that the term 'competent person' is used in several different pieces of legislation and there is a perception that the phrase means different things in the differing pieces of legislation, causing some confusion.

### 2.6 HOW LOLER APPLIES IN CARE HOMES

Within care homes, numerous pieces of lifting equipment and accessories are used and fall under the scope of LOLER, including lifting hoists, stand aids, slings, bath hoists, lifting platforms and stair lifts. Such lifting equipment is used to aid in the movement of patients and can also serve to reduce musculoskeletal risks to carers.

Most lifting equipment used within a care home will fall under the scope of LOLER since it can be defined as 'work equipment' and therefore will require maintaining in accordance with the Regulations. This means that the lifting equipment must be subject to a 'thorough examination' conducted by a competent person, either every six months or in accordance with an examination scheme and may also require inspecting andmaintaining-for example, it is likely to be necessary that slings are subject to pre use checks.

## 3. METHODOLOGY

**FOR THIS RESEARCH TWO DIFFERENT DATA COLLECTION TECHNIQUES WERE USED:**

1. Firstly the collection of primary data via an email which was sent to local authorities across England and Wales asking for feedback on their experiences in relation to lifting equipment and thorough examination reports that do not comply with the LOLER 1998

2. Secondly, once information was gathered from a review of literature and the email to local authorities, the collection of primary data via an anonymous questionnaire survey sent to a number of Residential Care Homes throughout Greater Manchester. Prior to sending the final questionnaire to the chosen sample the questionnaire was both pre tested and piloted. As part of this survey respondents were asked to return an 'example' copy of one of their last thorough examination reports. These were further analysed in order to determine whether or not such reports complied with Schedule 1 of LOLER.

Clearly in research it is important that a valid percentage of the population is targeted. A sample population of 100 was calculated using Creative Research System (2010) online survey software [16]. Through the researcher's liaison with local authorities throughout Greater Manchester, it was known that there were approximately 400 Residential Care Homes throughout the area. Using the online software, at a confidence level at 95%, with a confidence interval (margin of error at 8.5) the sample size needed was calculated at 100.

Prior to undertaking this research, ethical approval was sought from the University of Salford's Research Ethics Committee.

## RESULTS

### 4.1. EMAIL TO LOCAL AUTHORITIES.

In response to emails sent, several local authority officers expressed concerns that they had encountered thorough examination reports that did not comply with schedule 1 of LOLER, one raised concerns in relation to the issue of 'competency', and another concern raised included the issue of whether or not a competent person should isolate equipment when a serious defect was found. The feedback from local authorities, along with information gained from a review of relevant literature was then used to shape the format of the questionnaire.

### 4.2. SURVEY RESPONSES

In total forty two survey responses were received. Two surveys returned were returned blank, both responding that the homes didn't have any lifting equipment. For the purposes of analysis, these two surveys were therefore not included. The response rate overall therefore was forty percent.

### 4.2.1. JOB TITLE

The first part of the survey asked for the job title of the person completing the questionnaire. Most respondents indicated that they were a manager (57.5%). 22.5% of respondents did not complete the 'job title' section and 20% indicated 'other' responses. Considering that the majority of respondents indicated that they were a 'manager', it was therefore expected that these respondents would have at least some understanding of the LOLER Regulations.

### 4.2.2. AWARENESS THAT CERTAIN LIFTING EQUIPMENT MUST BE 'THOROUGHLY EXAMINED' AND OF WHAT EQUIPMENT NEEDS SUCH EXAMINATION

95% of respondents indicated that they were aware that certain lifting equipment within their Care Home required regular thorough examination in accordance with LOLER. These results are not surprising considering that the LOLER Regulations were introduced in 1998 and considering that the use of lifting equipment is integral to the care industry.

Question two asked respondents to 'tick' which pieces of lifting equipment they thought required a 'thorough examination' in accordance with LOLER. This question was asked to determine respondents' understanding of the application of the Regulations. Ten different pieces of lifting equipment were listed, eight of which do require thoroughly examining (when the equipment is 'work equipment') and two of which do not require a thorough examination in accordance with LOLER. The results of the survey can be seen in Table 1 below:-

### TABLE 1: WHICH EQUIPMENT REQUIRES A 'THOROUGH EXAMINATION?'

| Lifting Equipment | Percentage who thought that lifting equipment required a thorough examination |
|---|---|
| A lifting hoist (mobile) (Does require a thorough examination) | 100% |
| Slings (Does require thorough examination) | 75% |
| A lifting hoist (fixed) (Does require a thorough examination) | 92.5% |
| Profiling beds and trolleys (Do not require a thorough examination) | 42.5% |
| Stair lift (Does require a thorough examination) | 90% |
| A Lifting platform (Does require a thorough examination) | 87.5% |
| A riser recliner chair (Do not require a thorough examination) | 27.5% |
| A passenger lift (Does require a thorough examination) | 90% |
| A bath lift (Does require a thorough examination) | 97.5% |
| A bath hoist (Does require a thorough examination) | 97.5% |

Out of the total number of respondents, only 25% answered the entire question correctly. This provides worrying evidence considering the extent of the use of lifting equipment within this industry.

### 4.2.3. CONFIDENCE THAT RESPONDENTS UNDERSTAND THE DIFFERENCE BETWEEN A 'THOROUGH EXAMINATION' AND A SERVICE/ ROUTINE MAINTENANCE OF LIFTING EQUIPMENT

Question three asked respondents if they feel confident that they understand the difference between a 'thorough examination' and a 'service/routine maintenance' of lifting equipment. 87.5% ticked to say 'yes' (that they felt confident they understood the difference), 2.5% ticked 'No' and 10% ticked 'not sure'. These results suggest that the majority of respondents are clear on the difference between a 'thorough examination' and 'maintenance' which does not reflect what was discussed by Wright et al. [2].

### 4.2.4. EXPERIENCE WITH COMPETENT PERSON

Question four asked respondents to tick all answers which applied, in relation to what a 'competent person' usually did when their lifting equipment was thoroughly examined and any defects with the lifting equipment were found. 90% ticked to say that the competent person discusses verbally with someone on site immediately about the defects and how serious they are and 97.5% indicated that the competent person leaves a copy of the report on site. Worryingly one respondent indicated that the competent person will not discuss the examination with them or leave a copy of a report on site.

### 4.2.5. TRAINING AND KNOWLEDGE AND HOW RESPONDENTS LEARNT OF THE REQUIREMENTS

The survey asked respondents whether or not they had received any health and safety training. The majority (87.5%) answered 'yes' (that they had received training) and 12.5% responded no. The survey then asked respondents to indicate what health and safety topics they had covered on their training. In total 62.5% gave responses to this question, the most common topics mentioned by respondents being:-

- Answers which discussed them covering 'all health and safety topics' (12 respondents)
- Moving and Handling/Manual Handling (11 respondents)
- COSHH (9 respondents)
- Interestingly only three respondents mentioned LOLER within their responses.

Question six within the survey asked respondents how they learnt about the requirements in relation to 'thorough examination'. The majority of respondents, 55%, responded that they were self-taught by reading guidance documents. Additionally:-

- 42.5% indicated that they had learnt the requirements on a training course
- 40% had learnt through a recent visit by their local authority Environmental Health Officer/ Enforcement Officer
- 22.5% indicated they learnt of the requirements through their insurance company, and
- 17.5% gave 'other' responses

### 4.2.6. BENEFIT FROM FURTHER GUIDANCE?

The survey also asked respondents if they feel that they would benefit from further guidance or training from their local authority on the requirements of LOLER. In response to this question, over half of respondents (52.5%) indicated that 'Yes' they would benefit from further guidance or training.

#### 4.2.7. OPINIONS/VIEWS

The survey went on to ask respondents for their opinions/views on the requirement to have lifting equipment 'thoroughly examined'. On the whole most respondents responded positively to the question with answers such as:-

'It's essential and good management to have assets regularly checked and maintained'.

The majority of respondents mentioned 'cost' in their responses, examples being:-

'Very Costly but beneficial and also a requirement that all inspectors look at'.

(It is important to note that 'cost' was mentioned within the question as an 'example' therefore it is not unexpected that respondents would discuss cost within their answers).

Additional interesting points raised included:-

'I need a clear definition of 'competent person' What qualification is required to be a lift engineer?'

'Costly, Some companies (e.g ****!!) try to pass their 'recommendations' as requirements.'

'Yes-cost and accountability. We pay for a service-why is it not up to 'thoroughly examined' standards??'

### 4.3. AUDIT OF RETURNED THOROUGH EXAMINATION REPORTS

All returned example thorough examination reports were then audited for compliance with Schedule 1 of LOLER.

#### 4.3.1. WAS A SERVICE RECORD/MAINTENANCE RECORD RETURNED RATHER THAN A THOROUGH EXAMINATION?

Firstly all returned reports were audited to determine if they were clearly not a 'thorough examination' in accordance with LOLER, but were a service or maintenance record. The majority of reports returned were what looked to be a 'thorough examination report' however 14.3% of respondents returned what clearly was a service/maintenance record for the lifting equipment.

All respondents that returned service/maintenance records rather than thorough examination reports, all had also answered 'Yes' to question 3 of the survey (that they felt confident that they understood the difference between a 'thorough examination' and the 'service/routine maintenance' of lifting equipment) as discussed in 4.2.3 above. These results are interesting and suggest that although these respondents believe they understand the difference between a 'thorough examination' and 'routine maintenance' they in truth did not.

#### 4.3.2. ANALYSIS OF THE CONTENT OF THE THOROUGH EXAMINATION REPORTS RETURNED

Once a determination had been made as to whether or not the report returned looked to be a thorough examination report, those which were deemed to look like a thorough examination were then further analysed in order to determine if they complied with Schedule 1 of LOLER. Reports were deemed to comply with Schedule 1 of LOLER when they contained all the information specified within the Schedule.

In total 55.6% of the reports returned did not comply with schedule 1 of LOLER.

The most common information missing from certain reports included:-

- The date of the last thorough examination (with 28% of returned reports not containing this information)
- Details of the 'reason for the examination' I.e Whether it was a thorough examination, within an interval of 6 months under regulation 9(3)(a)(i); Within an interval of 12 months under regulation 9(3)(a)(ii); In accordance with an examination scheme under regulation 9 (3) (a) (iii);or after the occurrence of exceptional circumstances under regulation 9 (3) (a) (iv); (with 33% of reports returned not containing this information)
- (if such be the case) that the lifting equipment would be safe to operate (with 33% of returned reports not containing this information)
- The name, address and qualifications of the person making the report; that he is self-employed or, if employed, the name and address of his employer (with 28% of returned reports not containing this information)

Additionally reports were analysed to determine if there was a visible UKAS accreditation stamp on the report or if it was clear from the report that the company/engineer was a member of a relevant organisation such as SAFed. Only three of the reports contained a UKAS accreditation stamp or indicated membership of a relevant association. The three reports which contained UKAS accreditation or evidence of membership of a relevant association, all complied with Schedule 1 of LOLER.

## 5. DISCUSSION

### 5.1. KNOWLEDGE AND UNDERSTANDING OF LOLER AND 'THOROUGH EXAMINATION'

As discussed, it was not surprising that the majority of respondents were aware that certain lifting equipment required regular thorough examination in accordance with LOLER. It was however surprising and concerning to find that only 25% of respondents knew which pieces of equipment did/didn't fall under the scope of LOLER, with 25% of respondents believing that patient slings did not require thorough examination. These results are concerning as every year there are numerous accidents involving hoisting, which may well have occurred due to failure of equipment due to poor maintenance.

The HSE have produced several guidance documents in relation to LOLER and thorough examination, and in particular have produced two leaflets specifically aimed at the care sector; Getting to grips with hoisting people [1] which discusses hoisting and in particular discusses slings and the requirements in relation to thorough examination and; the more recent leaflet, How the Lifting Operations and Lifting Equipment Regulations apply to health and social care [6] which gives specific pictorial examples of the types of lifting equipment that require thorough examination. The results of this research therefore suggest that knowledge of the application of LOLER in terms of what type of equipment requires thoroughly examining is poor.

The results of this research also suggested that the majority of respondents felt that they were clear on the difference between a 'thorough examination' and 'maintenance' of lifting equipment. Interestingly however, several of the respondents who indicated that they did feel that they understood the difference, actually returned a service/maintenance record rather than a thorough examination report. This indicated that although they thought they understood the difference, in reality they did not. These results are comparable with Wright et al [2] who in their research prepared for the HSE, found that many were confused about the meaning of the terms 'inspection', 'thorough examination' and 'maintenance'.

In this study, although the majority of respondents felt confident that they understood the difference, there are still clearly a number of persons who do not understand the difference between a' thorough examination' and 'routine maintenance'.

### 5.2. EXPERIENCE WITH THE COMPETENT PERSON

In relation to respondent's experiences with competent persons conducting a thorough examination, it was encouraging to find that 90% ticked to say that the competent person discusses verbally with someone on site immediately about any defects found and how serious they are and 97.5% indicated that the competent person leaves a copy of the report on site.

This is encouraging as it suggests that the competent person referred to by the respondents are acting in line with Regulation 10 of LOLER, which requires the person making the examination to notify the employer forthwith of any defect which is or could become a danger to persons and which requires a report of thorough examination in writing to be made as soon as practicable. Worryingly however one respondent (2.5%) indicated that the competent person will not discuss the examination with them or leave a copy of a report on site.

Although it is reassuring to find that the majority of respondents have indicated that the competent person will discuss verbally with someone on site the defects and will leave a report, this raises the debate as to whether or not a competent person, should 'switch off' or 'take out of use' a piece of lifting equipment or accessory where a serious defect has been found, or whether this should be left to the responsibility of the duty holder. This topic was not explored in detail within this research and is potentially a further area of study.

### 5.3. TRAINING AND KNOWLEDGE

It was not unexpected that the majority of respondents had received some health and safety training and neither was it surprising that moving and handling/manual handling was one of the most mentioned topics considering that a major role in the care sector is the moving and handling of patients, which if not conducted correctly may result in severe injury.

Interestingly only three respondents mentioned LOLER within their responses. This could be an indication that either the majority of respondents have not been specifically trained on 'LOLER', perhaps training on other topics has been more prevalent then specific training on LOLER, or it may be that LOLER has been discussed as part of wider 'moving and handling training'. Further study into the details of training courses attended by respondents would assist in determining the level of training on the subject.

### 5.4. HOW DID RESPONDENTS LEARN OF THE REQUIREMENTS AND DO RESPONDENTS FEEL THAT THEY WOULD BENEFIT FROM FURTHER GUIDANCE OFF THEIR LOCAL AUTHORITY?

The results from this research suggested that the majority of respondents have learnt of the requirements of LOLER by 'self-reading' guidance documents. This is not unexpected considering that the HSE, have produced many guidance documents for the care sector which are available free online.

Only 40% of respondents had indicated that they had learnt the requirements through a recent visit by their local authority Environmental Health/Enforcement officer. This may be due to the fact that proactive inspections are becoming less and less frequent by local authorities, following the emphasis by the Government on deregulation and 'reducing the burden' on businesses.

Additionally just over half of respondents expressed that they would benefit from further guidance from their local authority. This may therefore be an area where local authorities may wish to focus some resource in order to improve compliance.

### 5. 5. OPINIONS/VIEWS

The final part of the questionnaire survey asked respondents for their views on the requirement to have lifting equipment thoroughly examined. Most respondents responded positively to the question. One notable point raised by one respondent was in relation to needing a clear definition of the term 'competent person' with the respondent asking what qualifications are required to be a lift engineer? This corresponds with what was found by Wright et Al. [2] who reported that 'competent person' is not a well understood phrase.

It could be argued that the introduction of a 'register of competent persons' in relation to lifts may make it easier for the duty holder to ensure that the person they chose to use is competent and additionally may reduce the frequency of lift companies/competent persons not complying with the requirements of LOLER.

### 5.6. AUDIT OF THE RETURNED THOROUGH EXAMINATION REPORTS

The returned thorough examination reports were audited and highlighted some interesting results. As discussed above, it was noted that several of the reports returned were not in fact thorough examination reports. They clearly were service/maintenance records.

Of those reports returned, 55.6% of the reports did not comply with Schedule 1 of LOLER with important information missing on some reports. Numerous reports did not contain details of the qualifications of the competent person, however this was not unexpected considering that there are no specific 'qualifications' that a 'competent person' must possess to prove competency. Again, this could become confusing for the duty holder, who will more than likely not have the knowledge and understanding to be able to determine if the 'competent person' they are employing is in fact 'competent'.

Another interesting point that the research has shown was that out of those reports audited, three reports contained evidence of accreditation with UKAS or evidence that that lift company/competent person was a member of a relevant association. Interestingly, all three of these reports complied with Schedule 1 of LOLER. These results may be of interest to non-accredited or non-affiliated lift businesses, who may want to ensure that they can compete with such companies.

## 6. CONCLUSIONS AND RECOMMENDATIONS

### 6.1. CONCLUSIONS

The overall aim of this research project was to gain a further more detailed picture of what compliance levels are in Care Homes, in relation to thorough examination of lifting equipment (as required under LOLER) and to determine if 'duty holders' within the Residential Care Home setting, have sufficient knowledge and understanding of the requirements of LOLER in relation to thorough examination of lifting equipment in order to achieve compliance.

From surveying a sample of Care Homes throughout Greater Manchester, this study came to several notable conclusions. The research found that the majority of respondents have some awareness of LOLER and the fact that certain lifting equipment required thoroughly examining in accordance with the Regulations, however it has found that respondent's knowledge in terms of which types of equipment did/didn't fall under the scope of LOLER was poor. For example, 25% of respondents thought that patient slings did not require a thorough examination-a conclusion that has proved to be concerning. The survey also found that many respondents felt that they were confident that they understood the difference between a 'thorough examination' and 'maintenance' of lifting equipment, although there was evidence that some respondents did not understand the difference.

With regard to respondent's experience with 'competent persons' it was positive to find that the majority of competent persons discuss verbally with someone on site immediately about any defects found during a thorough examination and that the majority leave a copy of the examination report on site suggesting that the majority of competent persons are acting in line with Regulation 10 of LOLER.

With regards to training it was found that the majority of respondents had received health and safety training but only a small proportion 'mentioned' LOLER as being a topic covered on their training. Additionally the survey found that the majority of respondents were 'self-taught' on LOLER and 'thorough examination', by reading guidance documents. The survey also found that over half of respondents thought that they would benefit from further guidance or training from their local authority. Additionally respondents were asked for their opinions/views and several interesting points were raised, including one particular respondent wanting clarity on the term 'competent person'.

Interestingly the research also found that the majority of thorough examination reports audited for compliance with Schedule 1 of LOLER, did not comply with the Schedule.

Overall, the research found that compliance levels in relation to 'thorough examination' of lifting equipment within care homes was poor with the majority of reports being returned not complying with the Regulations. Also although respondents in the main seem to have some understanding of the Regulations, further work must be done to ensure that awareness and understanding is improved. The research suggests that respondents (who in the main were managers and who are most likely therefore to be responsible for ensuring that lifting equipment is appropriately examined and maintained) do not have sufficient understanding of the requirements of LOLER in relation to thorough examination of lifting equipment in order to achieve compliance.

### 6.2. RECOMMENDATIONS

It is recommended therefore that:-

- The HSE and local authorities focus a campaign for the care sector on raising awareness of LOLER and the thorough examination requirement.
- The HSE and local authorities also work collaboratively to address 'competent persons' and lift companies who are producing certification that does not comply with Schedule 1 of LOLER
- The feasibility of a 'register of competent persons' in relation to lifts (i.e. similar to the Gas Safe Registration Scheme) be further explored and if feasible, devised. This could be devised by industry with HSE backing.

### 6.3. LIMITATIONS OF THIS RESEARCH PROJECT

Although a postal survey was the main preferred method of data collection within this research project due to time constraints and due to the fact that a larger population could be targeted, it must be noted that the use of postal questionnaires does pose some limitations such as low response rates. Low response rates can increase the chance of research bias. It is therefore recommended that this research be expanded to include a larger sample of Care Homes.

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## BIOGRAPHICAL DETAILS

Laura Smith (MSc Occupational Safety and Health), is a health and safety regulator working for Oldham Council, who specialises in the enforcement of Health and Safety legislation including the Lifting Operations and Lifting Equipment Regulations 1998.

This research was conducted as part fulfilment of an Msc in Occupational Safety and Health at the University of Salford.

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# A BRIEF HISTORY OF LIFT SAFETY DEVICES 1835-1935

**LEE E. GRAY**
College of Arts + Architecture, University of North Carolina at Charlotte, Charlotte, North Carolina USA 28223

**Keywords:** history, safety devices.

**Abstract:** The history of lift technology is, essentially, the history of lift safety devices. Passenger safety has always been a primary focus of the lift industry and all aspects of lift technology are typically designed with regard to safety. For over 175 years the invention of safety devices has followed a developmental pattern predicated on an assessment of risk, the needs of different lift types, lessons learned from actual lift operation, and changes in lift systems and technologies. Critical safety concerns have included rope failure, overspeed, access to lift cars and shafts, automatic door operation, and leveling. This paper will offer a chronological outline of the development of lift safety devices and will, when possible, link the appearance of a given safety device to a specific cause, determining factor, perceived problem, or change in use. This paper examines the first 100 years of lift safety devices and will reveal that the development of these systems followed both logical and (occasionally) somewhat illogical paths.

## 1. INTRODUCTION

The following outline of the history of lift safety devices from 1835 to 1935 touches on some of the key developments that occurred in England and the United States during the period under investigation.

The primary materials examined for this study include the American patent record and scholarship produced by the author over the past twenty years. This paper does not attempt to present a comprehensive history of lift safeties. The goal is to provide an outline that highlights key moments in this important story.

## 2. 1835: THE TEAGLE

The design of William Strutt's North Mill at Belper, England, built in 1803 /04, included the installation of one of the first mechanized lift systems [1]. The machine, which became known as a "Teagle," was a belt driven platform lift used for transporting goods and workers in the five-story mill. A description of the lift published in 1835 revealed that between 1804 and 1835 several safety systems were added to the original lift.

These included a shaft safety gate and safety stops. The safety gate was designed to prevent the gate from being opened if the lift platform was not present at the landing. The safety stops were balls placed on the shipper rope such that, if the car passed the upper or lower landing it would strike a ball, which would move the shipper rope and stop the lift's movement (Fig. 1). The origin of these safeties is unknown. They were likely developed in response to lift accidents that occurred in the mill.

## 3. 1854: SAFETY HATCHES

The first patent for a lift safety device appeared in 1854 and concerned a design for automatically operating shaft hatches, which were located at each floor [2]. Invented by Daniel Tallcot, the safety was designed to ensure that unwary factory or mill workers could not fall down the lift shaft. As the lift platform moved through the shaft it encountered a cam and spring system that opened and closed the hatches (Fig 2.) In his patent text Tallcot reported that, although many lifts employed shaft doors, these were often left open and thus accidents occurred.

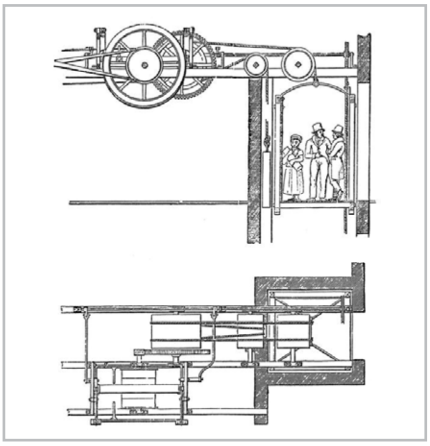

**Figure 1 The Teagle, William Strutt's North Mill, Belper, England (1835)**

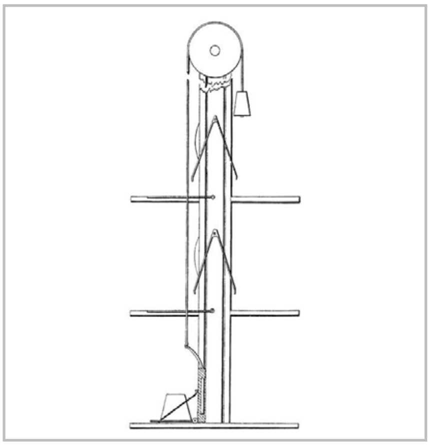

**Figure 2 Safety Hatch, Daniel Tallcot (1854)**

## 4. 1854: THE RATCHET & PAWL SAFETY DEVICE

In 1854 Elisha Graves Otis exhibited his ratchet & pawl safety device at the New York Crystal Palace (Fig. 3) [1, 3]. Otis was the first to propose integrating a safety into the design of the lift platform. His device was intended to ensure that the platform would not fall if the hoisting rope failed. His exhibition also marked the first (and possibly only) public exhibition of the operation of a lift safety device. Although he initiated the process to patent his design in 1854, Otis later withdrew this application [1].

## 5. 1856: THE FIRST RATCHET & PAWL SAFETY DEVICE PATENT

In 1856 Hugh Baines, an architect practicing in Manchester, England, received a patent for a ratchet and pawl safety device that resembled Otis' design in its proposed operation, whereby if the hoisting rope broke ratchets would be released and engage racks, thus stopping the lift platform (Fig. 4) [4]. Baines claimed that his invention represented:

a novel method of stopping or retaining the ascending or descending room, chamber, or box employed in "hoists" in warehouses, mills, factories, pits, etc., for conveying persons and goods from one floor or height to another, in the event of the rope breaking, or the occurrence of any other equivalent accident, which would cause or allow the room or chamber to fall to the bottom of said shaft, thereby endangering life and property [4].

While the inventor's rationale focused on the most common cause of lift accidents – rope failure – he also alluded to other unspecified causes of accidents.

**Figure 3 Elisha Graves Otis safety exhibited at the New York Crystal Palace (1854)**

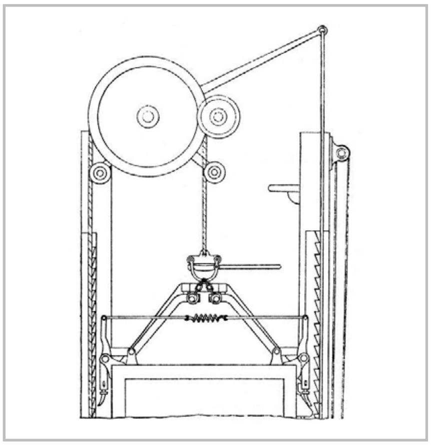

**Figure 4 Hugh Baines, Ratchet and pawl safety patent (1856)**

## 6. 1857: THE FIRST SAFETY DEVICE TEST ACCIDENT

In addition to receiving the first patent for a ratchet and pawl safety device, Baines has the unfortunate distinction of beging the first to be involved in a safety test accident [5]. In April 1857 he had his safety installed on an existing lift in Pender & Co.'s Warehouse in Manchester. The lift, carrying four passengers (including Baines), was raised to the top floor, and the hoisting ropes were "disconnected." The safety failed to act and the car fell 60 feet to the bottom of the shaft, resulting in one fatality, two serious injuries, and the inventor receiving a "severe laceration of one foot" [5]. The cause of the safety's failure is unknown (Baines alleged that previous tests had been successful). This tragic event reveals an aspect of safety development that remains unexplored: the history of lift safety testing.

## 7. 1859: THE FIRST AIR CUSHION SAFETY DEVICE

In 1859 Albert Betteley patented the first "air cushion" safety device [6]. The lift platform featured a tapered "parachute" like structure that, when it entered a reservoir at the base of the shaft would compress the air in the reservoir, which would be slowly released around the edges the platform (Fig.5).

Betteley's rationale was that there was a clear need to supplement existing rachet and pawl safeties because of their "inefficiency in preventing the fall of the car in many cases, as for instance when some part of the machinery gives way beyond the rope, or where, as may be the case, the rope breaks and is subject to sufficient friction to keep the pawls from falling into the rack until the car acquires such a momentum as to destroy the racks and pawls when they act" [6].

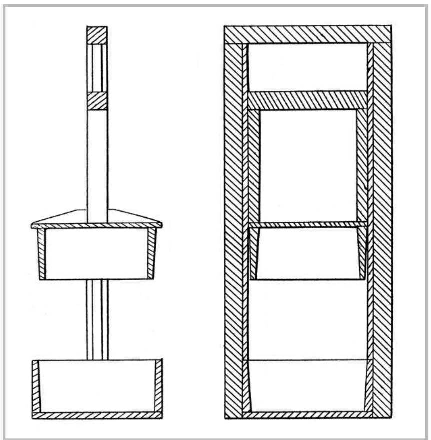

**Figure 5 Albert Betteley, Air cushion safety device (1859)**

## 8. 1859: THE VERTICAL RAILWAY

In 1859 Otis Tufts patented his "vertical railway" elevator that replaced hoisting ropes with a screw-shaft that extended the height of the building with the car traveling along the shaft (Fig. 6) [7]. His goal was to avoid the "extreme and ordinary dangers of suspension upon chains, ropes, or cords of any kind, in the safety of which, every additional experience has led me to place less and less reliance" [7]. In addition to eliminating hoisting ropes, Tufts provided other safeties, including a speed governor, an automatic safety stop (located at the top of shaft) and a buffer (located at the bottom of shaft). He was also the first lift designer to propose using an enclosed car to carry passengers (in order to ensure their safety), and he was one of the first to place the controller or shipper rope inside the car.

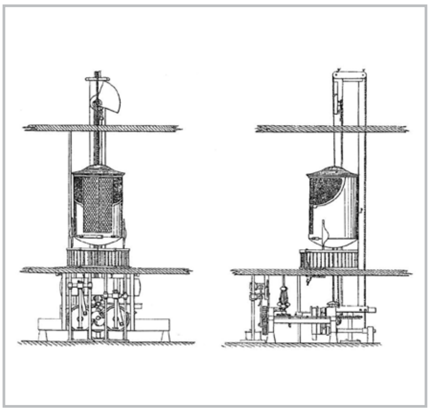

**Figure 6 Otis Tufts, Vertical railway elevator (1859)**

## 9. 1859: THE FIRST INTERLOCK DOOR SAFETY DEVICE

In 1859 Albert Betteley patented the first interlock door safety system that featured interlocking shaft and car doors [8]. It employed a device operated by a series of cams and springs such that, when the car door was open, the safety automatically "grasped" the shipper rope and prevented its use, thereby holding the car stationary (Fig. 7). Betteley's use of ordinary hinged-doors followed the established door-type used on lifts at this time.

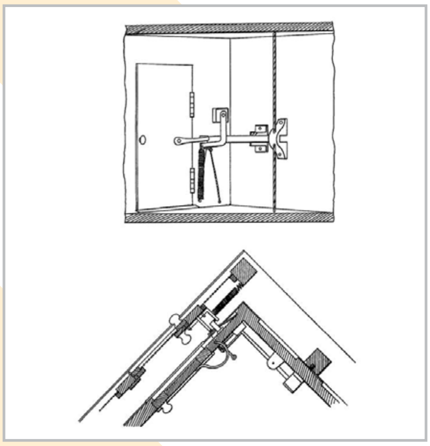

**Figure 7 Albert Betteley, Interlock door safety device (1859)**

## 10. 1859: THE FIRST SAFETY LIFT

In a December 1859 advertisement for his lift company, Elisha Otis stated that "not a single" accident had occurred to one of his "improved safety elevators" [9]. This marked the first use of the phrase "safety elevator" in the United States. From this date forward, most manufacturers referred to their products as "safety elevators" or "safety lifts."

## 11. 1861: THE SECOND RATCHET & PAWL SAFETY DEVICE PATENT

In 1861 Elisha Otis finally patented his ratchet and pawl safety device (Fig. 8) [10].

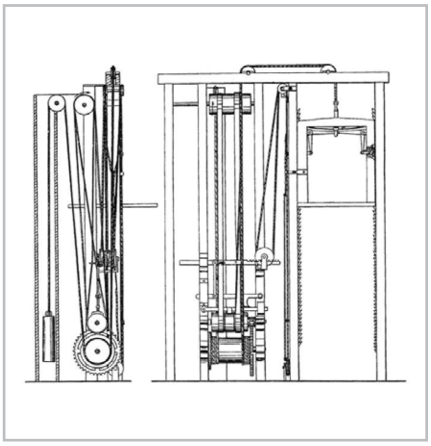

**Figure 8 Elisha Otis, Ratchet and pawl safety device patent (1861)**

## 12. 1861: AN EARLY OTIS ELEVATOR ACCIDENT

On February 1, 1861 an accident occurred involving one of Otis' improved safety elevators [11]. Following routine maintenance (which involved replacing the hoisting rope) on an Otis lift in Struelens & Palmer's factory in New York, the lift traveled to the fifth floor here it was loaded with goods. As the lift began to descend the hoisting rope, which had not been properly secured, came loose and the car fell. The safety did not engage until the lift reached the second floor. The resulting "force of concussion" killed an employee on the lift and injured Nazaire Struelens, who had been standing near the second-floor lift entrance [11]. Following an investigation, Elisha Otis reported that the car's framework "had been racked out of shape in such a manner as to prevent the operation of the safety spring" [12]. Otis also stated that he had "never warranted elevators to be perfectly safe, as their safety depends in some measure upon their reasonable care and usage by the operator, over whom I can have no control" [12]. This was one of the first public acknowledgements that safe lift operation was not solely dependent on the efforts of lift manufacturers. The tragedy of this accident was compounded in March 1861 when Struelens, while reaching for the shipper rope, slipped and fell down the unguarded shaft to his death [13].

## 13. 1864: THE FIRST OVERSPEED SAFETY (DIRECT ACTION HYDRAULIC LIFT)

In 1864 Easton, Amos & Sons designed a speed regulator for use on the direct-action hydraulic lift installed in the Brighton Hotel (Fig. 9) [14]. The regulator was described as:

a cast iron box or chamber, through which the water passes on its way to and from the cylinder, and in which is suspended on a center a brass quadrant, the face of which fits accurately the face of both the inlet and outlet passages … When the velocity of the water, in either direction, does not exceed that decided upon, the swinger hangs in a vertical position without moving, but the instant the velocity increases beyond that point … the swinger rises and closes the passage to such an extent as to reduce the speed to the normal velocity [14].

The safety was unusual in addressing the possibility of overspeed in a hydraulic lift. This device was also the first to address overspeed in the "up" direction.

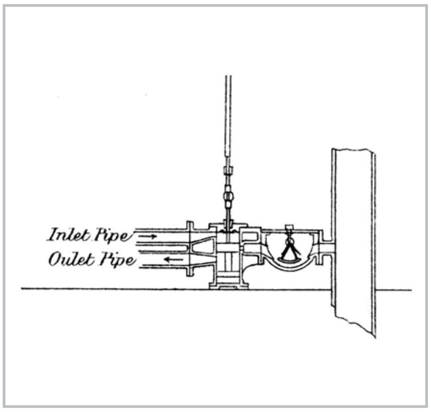


**Figure 9 Easton, Amos & Sons, Overspeed safety for a direct-action hydraulic lift (1864)**

## 14. 1865: THE FIRST OVERSPEED SAFETY (STEAM POWERED LIFT)

In 1865 Charles R. Otis patented the first overspeed safety designed for use on steam powered, winding drum lifts (Fig. 10) [15]. The design employed a safety drum located at the top of the shaft, which used a flyball governor to control the action of a brake.
The safety was attached to car such that the car's speed determined the governor's rotational speed. If the car exceeded a predetermined speed the governor would activate the brake. Charles Otis, acknowledging earlier criticisms of his father's original safety device, stated that the overspeed safety was needed in the event of an accident where the action of the falling car failed to trigger the ratchet and pawl safety.

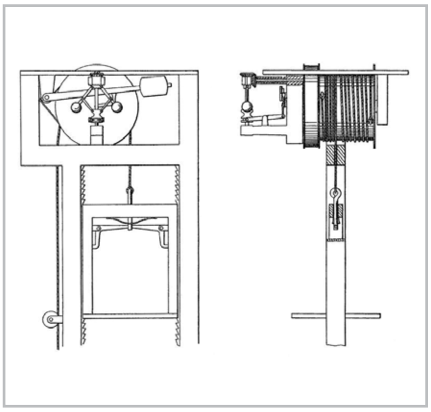

**Figure 10 Charles R. Otis, Overspeed safety for a steam powered lift (1865)**

## 15. 1879: THE SECOND AIR CUSHION SAFETY DEVICE

In 1879 Albert C. Ellithorpe patented the second "air cushion" safety device (Fig, 11) [16]. His rationale and design were similar to Betteley's, with the primary difference between the two designs being the addition of an automatic air valve that opened to admit air into shaft as car ascended and closed as the car descended. Ellithorpe also recommended the use of sliding doors to keep the shaft as "air tight" as possible. The critical difference between these inventions was the fact that, unlike Betteley, Ellithorpe was able to successfully market his safety device across the United States.

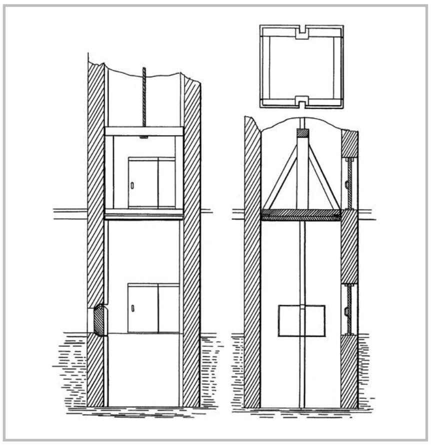

**Figure 11 Albert C. Ellithorpe, Air cushion safety device (1879)**

## 16. 1884: (ANOTHER) OVERSPEED SAFETY

In 1884 Adolphe Gallinant patented an overspeed safety that consisted of a series of fan blades attached to a mechanism mounted at the of the shaft (Fig. 12) [17]. The mechanism was attached to the top of the car via a rope such that the car's movement caused the fan blades to rotate. The blades were designed to close as the car ascended and open as it descended, and chains were used to prevent the blades from opening too far. The car's speed was allegedly controlled by moving the blades on their supports. Nothing is known about Gallinant other than the fact that he immigrated to the United States from France in 1872/73 and that he apparently had no connection to the vertical transportation (VT) industry. This safety is representative of hundreds of devices patented during the 19th century by people outside the VT industry. These patents represent another unexplored topic: in spite of their idiosyncratic and often impractical nature, they serve as an important indicator of the public's general awareness of the need to ensure safe lift operation.

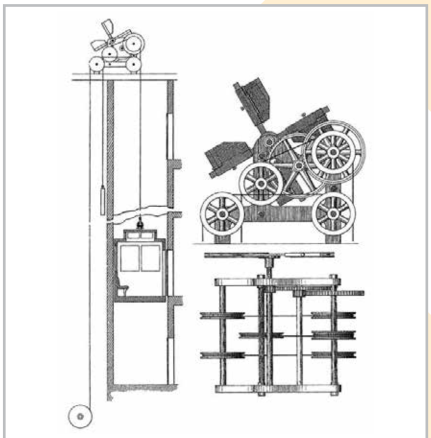

**Figure 12 Adolphe Gallinant, Overspeed safety device (1884)**

## 17. 1897: THE FIRST UNDER-CAR OVERSPEED SAFETY

In 1897 Charles R. Pratt patented one of the first under-car overspeed safety devices [18]. Pratt's design was, in many ways, made possible by the development of modern steel guide rails in the early 1890s [19]. Earlier car mounted safeties were typically located atop the car and were designed to engage wooden guide rails. The presence of narrow steel guide rails allowed Pratt to propose using spring activated clamps that grasped the sides of the rails (Fig. 13). The action of his safety was controlled by a flyball governor whose speed was determined by the car's movement.

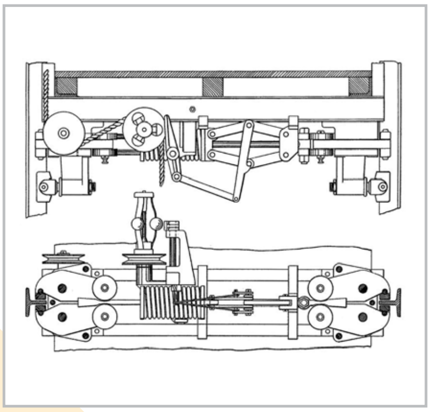

**Figure 13 Charles R. Pratt, Under-car overspeed safety device (1897)**

## 18. 1899: THE FIRST IN-CAR COMMUNICATION SYSTEM

The Park Row Building in New York, completed in 1899, utilized the first lift cars that employed an in-car communication system; the cars were equipped with telephones that allowed lift operators to immediately report operational problems to the building's engineer [20].

## 19. 1903: (ONE OF) THE FIRST ELEVATOR THRESHOLD SAFETY DEVICES

The absence of automatic elevating systems inspired inventors to devise safety devices to help passengers enter and exit cars that were not perfectly level with their landings [21]. Once such safety, developed by George Hail, involved placing lights either inside the car or on the landing that were directed at the threshold to help passengers to see if the car was level (Fig. 14) [22, 23].

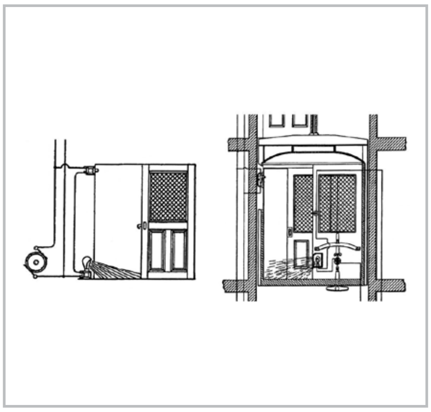

**Figure 14 George Hail, Elevator threshold safeties (1903)**

## 20. 1900-1915: AUTOMATIC LEVELING SYSTEMS

Designing an effective automatic leveling system was defined in terms of solving two related problems [24]. The first problem concerned the design of a cost-effective means of automatically slowing the car speed to approximately 15 feet per minute as it approached the landing. The second problem involved designing a means by which the car, now moving at a slow speed, would automatically stop level with a given landing and automatically "inch" back to a landing should it go past level [25]. In 1903 Harold Rowntree patented a design that solved the first problem. He proposed to switch from the main motor to an auxiliary slow speed motor as the car approached a landing [26].

In 1913 August Sundh patented a solution to second problem [27]. His design employed a controller mounted on the car that was connected to a chain that ran from the top to the bottom of the shaft. As the car traveled through the shaft the chain rotated sprocket wheels in the car controller that in turn rotated contact points that governed the flow of current to the hoisting motor and controlled the activation of the brake. The mechanical movements within the controller were determined by the height between individual floors, which was keyed to the number of chain links that passed over the sprockets. If the car traveled past the landing the controller would detect this movement and the car would automatically reverse its motion and level itself.

## 21. 1931: THE FIRST DOOR REVERSAL SAFETY DEVICE

The development of interlocking, automatically operating sliding lift doors in the 1920s created a new safety hazard: the possibility of passengers being injured by the closing doors [28]. In 1931 two Westinghouse engineers, Luther J. Kinnard and James Dunlop, patented an automatic door reversal safety device [29]. They described the need for their invention and its basic operational characteristics as follows:

In operating an elevator having a power-controlled gate, it is desirable to provide some means for preventing the passengers from being injured by a premature closing of the gate while they are entering or leaving the car. Therefore, we have devised a means for preventing the gate from closing until the doorway, or entrance, to the car is clear. This means comprises … a photoelectric cell and a cooperating source of light … mounted in the entrance to the car for operating a safety relay, the contact members of which are included in the circuit for the door-operating mechanism [29].

The inventors also stated that it was an "object of our invention to provide for reopening the door or gate and retaining it in such open position for a predetermined length of time when anyone steps into the entrance to the elevator while the door is in the act of closing" [29]. Their design employed two pairs of lights and photoelectric cells, one mounted in the car and one the landings, that could be used to detect passengers' movements in and out of the car (Fig. 15).

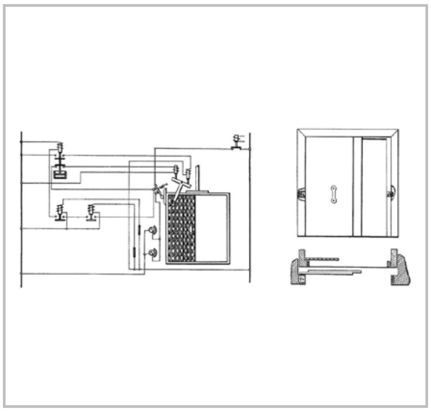

**Figure 15 Luther J. Kinnard and James Dunlop, Door reversal safety device (1931)**

## CONCLUSION

This brief examination of the history of safety devices reveals the need for a comprehensive study of lift safeties. Such a study would involve a careful examination of the patent record in the United States and Europe, the relevant technical literature, accident reports, lift codes and regulations, and manufacturer's catalogs. The product of such an investigation would be a comprehensive history of lift development. While several lift histories have appeared over the past 50 years, none of them offers readers a work that encompasses all of the topics referenced above (1, 30, 31).

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## BIOGRAPHICAL DETAILS

Dr. Lee E. Gray is the Senior Associate Dean in the College of Arts + Architecture at the University of North Carolina at Charlotte and a Professor of Architectural History in the School of Architecture. He received his Ph.D. in architectural history from Cornell University, his Masters in architectural history from the University of Virginia, and undergraduate degrees in architecture from Iowa State University. He is the author of From Ascending Rooms to Express Elevators: A History of the Passenger Elevator in the 19th Century. Since 2003 he has written monthly articles on the history of vertical transportation for Elevator World magazine. Current projects include a book on the history of escalators and moving sidewalks.

# A LIFE IN THE DAY

**Gina is an independent vertical transportation consultant, as well as community stalwart, and we gained a little insight to her passions.**

We sat down with lift industry veteran, Dr Gina Barney to talk about her life in the industry and outside of it.

**WITH SAFETY AT THE TOP OF OUR MINDS AS THE THEME OF THIS ISSUE, WE ASKED GINA ABOUT THE STANDARDS SHE'S INVOLVED WITH.**

"I'm currently working on BS 7255:2012, code of practice for the safe working on lifts. It's a very important document, focused on people, not equipment, ensuring people are safe. This one is now out of date, as some of the standards have changed. As lifts have got safer, some things are no longer relevant as they've been dealt with. But this will apply to any lift, regardless of age; you have to cover all of those in such an important document.

"We've got a panel - Nick Mellor is the convener of the panel and I am acting as the secretary of it - and we are drawing it all together. The document was in two parts – the owner and the worker – and covered each safety element from either side. So, for example, the owner has the responsibility to provide the rubber mat, the worker has the responsibility to use it – this would be split into the two separate sections.

"All this information was disjointed, so we pulled it together into simplified sections, so both parties can see where the responsibilities lie and one can admonish the other if they're not adhered to. It's also supported with lots of annexes for reference.

"We did a first run at it, we sent it out to 11 people and we got back 300 comments! So we've been working through those comments to improve the original text and decide on solutions.

**"That's the British standard I'm working on, but there's international work too – I'm working on the energy efficiency of lifts and escalators."**

**GINA'S BEEN WORKING WITH DR GERHARD SCHIFFNER ON CLASSIFYING THE ENERGY EFFICIENCY OF LIFTS AND ESCALATORS, AS WELL AS REVISING THE ASSOCIATED STANDARD.**

**"There are three parts to this standard, how to do the measurement, how to apply it to lifts, and how to apply it to escalators. These are two very different things – one – the lift – is built on site and the other – the escalator – comes from a factory, so they need to be dealt with differently. Anna Marie Lorente was instrumental in doing the research we're using, to get the results, and we have generated some tables and produced formulae. This means we can calculate the energy take and classify the lift, like we do with white goods, with an energy rating.**

"We can classify the standing energy that's taken, which is in two parts – as soon as the lift stops there is a certain amount of idle energy, then it goes into standby. Then there's running energy, so we've got tables for both.

**"We are currently revising part one and two, and a specialist escalator subgroup in Austria is looking at part three. Gerhard and I have come up with a simple solution for part two which is now going forward as an amendment."**

**EVACUATION LIFTS ARE A HOT TOPIC RIGHT NOW, AND GINA HAS BEEN WORKING WITH NICK MELLOR ON A NEW STANDARD FOR EVACUATION LIFTS.**

"With evacuation lifts, it's difficult to decide how many lifts, how big they are, to evacuate anyone, with any disability; we've got to get them out. The way that we would get them out is to have designated lifts that are normally passenger lifts, but they become special evacuation lifts in the event of an emergency. Nick is writing a paper to describe the lift and the actual equipment. The London Plan has said that the capacity should be calculated, but it is very vague, it doesn't say how! So we're trying to give them some method of being able to do it. We want a BREEAM equivalent for design, deciding the size of the lifts and how quickly people can get out of the building. Normally, for firefighters' lifts, they're supposed to be able to survive two hours, to allow firefighters to move around the building, so in evacuation, we've got a similar situation, we want to be able to get people out. Normally they talk about being able to get people out in five or ten minutes, and in a house we can get out in a couple of minutes, it's very easy, but once you start to have floors above one another it becomes much more difficult, especially if people get stuck on the stairs."

**GINA TOLD US A LITTLE BIT MORE ABOUT HER INVOLVEMENT WITH CIBSE LIFTS GROUP, AS WELL AS THE OTHER GROUPS AND COMMITTEES SHE'S INVOLVED IN.**

"I joined CIBSE Lifts Group donkey's years ago, because anyone that's interested in lifts can join, not only those who are CIBSE members. We provide a forum for discussion of lift topics. It's mostly consultants and we have a scattering of manufacturers and suppliers who attend, but we've come to represent the consultancy side.

"We had our CIBSE Lifts Group event on the 7 June in Manchester, themed on the London Plan, and there'll be our annual seminar in London as well, but we're not sure what the theme is for that one, to be quite honest!

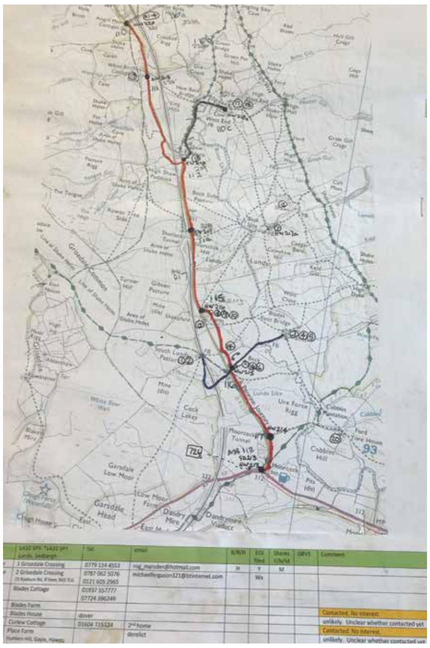
"I'm involved in the Professional Conduct Committee, which I joined as there were no women on it. I'm actually the oldest person on it! We have a reasonable spectrum of individuals and it deals with complaints about members – if someone has misbehaved professionally and somebody makes a complaint against them, we will have a look at it. So we can actually throw people out of the institution if they're particularly in the wrong!

"The other committee, which has only just been proposed is the Equality and Diversity Committee, which has a number of sub-groups in it. I've been invited to sit on the LGBT+ Committee, because there is still some discrimination amongst members of CIBSE, and those that don't adhere to the general principles of respect.

"One priority is to get the Charter changed, because the Charter is all male dominated, and Ruth, the CEO, is very keen to get that changed. It's not too difficult to do, but you have to go to the Privy Council to do that."

**IN ADDITION TO ALL THE GROUPS AND COMMITTEES GINA IS INVOLVED WITH, SHE STILL FINDS TIME FOR HER CONSULTANCY WORK, AS WELL AS WORKING WITHIN HER LOCAL COMMUNITY.**

"I don't do a great deal of consultancy, but I've got a project in a building in Liverpool at the moment. It's a heritage building which developers want to turn into offices, but you can't do a lot in a heritage building to change things, so I'm doing that. Most of the work I do is expert witness work,




rather than simple consultancy, and that ebbs and flows. Sometimes you'll have half a dozen cases running, and sometimes none. I do expert witness work for either the prosecution or defendant, it doesn't bother me, or sometimes as a single joint expert for both, which the court likes as they've only got two opinions from one expert, rather than experts that don't agree with one another!

"Within my community I'm treasurer of the little local church. We have a very small turnover of around £6000 a year, so it's not a very difficult job! I'm also secretary of the Community Trust, which is a community interest organisation, whose main purpose is to raise funds from the charity shops and dispense them to good causes within our area. It funds everything from buying sports equipment to sorting out the community orchard, and sheltering smaller groups to help them get going. The People's Hall is my main activity, a community hall where I'm treasurer and secretary. We've raised £600,000 since 2013 to make a whole host of improvements and renovations, and we're continuing to fix the main hall with heating and other improvements."

**GINA'S BEEN INVOLVED IN B4RN – BROADBAND FOR THE RURAL NORTH – AND HAS PLAYED AN INSTRUMENTAL ROLE IN GETTING FIBRE BROADBAND WITHIN HER VILLAGE, AND SUPPORTING OTHERS IN THEIR JOURNEYS.**

"The Government said it could get superfast broadband to 90-95% of properties in the country, but rural areas wouldn't be well served, so there are a number of groups that have started within the country to actually do it ourselves. B4RN provides 1000 MB capacity to properties, and depends on volunteers who actually walk the fields and put in the ductwork. Local villages who would like decent broadband go to B4RN and B4RN provide the structure and support for volunteers to install it. They bring in contractors for particular parts of it, and expertise for working out the network and IP addresses, but volunteers are actually laying the ductwork.

**"I've been part of the team laying ductwork for my area as well as another ten miles away. I do everything except splicing – it's a fiddly job! I probably put in 100 properties, drilling holes in walls! I love to help, it's a very worthwhile project. The Department for Digital, Culture, Media and Sport (DCMS) got a hold of the story and decided to feature me in a video about #ProjectGigabit, championing broadband and B4RN, which is on YouTube."**

Thank you to Gina for giving us an insight to her world.

You can scan the QR code to view the video and find out more about the valuable work Gina is doing in her community.

INTERNATIONAL LIFT EQUIPMENT

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# NEWS FROM THE CIBSE LIFTS GROUP

**RICHARD PETERS**
Treasurer, CIBSE Lifts Group

## Introducing standards

For a comprehensive overview of standards, directives, acts and regulations relating to the lift and escalator industry, the best starting point is CIBSE Guide D 2020 Transportation Systems in Buildings, Chapters 17 and 18. A pdf copy of CIBSE Guide D is available free to members of CIBSE and costs £45 for non-members.


*https://www.cibse.org/knowledge/knowledge-items/detail?id=a0q3Y00000I1ppmQAB*

MHE/4 is the British Standards (BSI) committee responsible for UK input into the work of CEN/TC10 and ISO/TC178 relating to lifts, hoists (excluding builders hoists), escalators and passenger conveyors. BSI MHE/4 currently has oversight of 84 published standards and is working on another 43.

CEN, the European Committee for Standardisation, is an association that brings together the National Standardization Bodies of 34 European countries. CEN/TC10 is responsible for establishing safety rules for the construction and installation of lifts, service lifts, escalators, and passenger conveyors.

ISO is the International Organization for Standardisation. They develop and publish International Standards. ISO/TC178 is the committee addressing standardization of all aspects (including safety) of lifts, service lifts, escalators, passenger conveyors and similar apparatus.

## MHE/4 report

Adam Scott and Dr Gina Barney both sit on the BSI MHE/4 committee and regularly report its activities to the CIBSE Lifts Group. Adam is the MHE/4 representative for the Chartered Institution of Building Services Engineers (CIBSE) and Gina is the representative for the Institution of Engineering and Technology (IET).

Here is a summary of their key points from the MHE/4 meeting on 3 February 2022:

- Declarations of Conformity should now be referencing the designated standards. Cars can continue to display the CE mark until the end of 2023 if there are accompanying documents including the UKCA mark.
- An Approved Document M review is underway. It will provide evidence on spatial requirements for wheelchairs and trolleys.
- The committee is currently reviewing a working draft of BS5655-6, Code of practice for selection, installation, and location of new lifts.
- BS5606, a guide on accuracy and tolerance in design and construction has now been published.
- An update on BS EN81 Part 28, Remote alarm on passenger and goods passenger lifts is underway.
- The Fire Service is concerned about the quality of retrospective fire stopping being carried out in the building trade.
- A review is taking place as to whether escalator auxiliary brakes need to be initiated by a speed sensor on the main drive shaft instead of the motor. There have been examples of where the chain has broken between the gearbox and step band; the motor has overspeed, but the auxiliary brake has not worked.
- May 2022 should see the new BS Part 76, Evacuation of persons with disabilities using lifts, being made available for public comment.

## Firefighting and Evacuation Lifts

At the CIBSE Lifts Group AGM on 2 February 2022, Nick Mellor, Managing Director of the Lift and Escalator Industry Association (LEIA) gave a presentation discussing the relationship between BS EN81-72: 2015 and BS EN 81-72:2020, considering published interpretations and London Fire Brigade's approach to deviations. These themes were developed further at the CIBSE Lifts Group meeting in Manchester, on 7 June 2022.

In his February presentation, Nick explained why calls to modernise lifts to be "firefighting lifts" are erroneous. He discussed BS 8899, a Code of Practice for the improvement of fire-fighting and evacuation provisions in existing lifts.

Nick introduced evacuation lifts as an ever-changing topic. BS 9999, Annex G provides the only description of an evacuation lift in British Standards. Nick also provided a resume of the work going on looking at means of escape for disabled people and evacuation lifts.

You can watch Nick Mellor's presentation by following

***https://www.youtube.com/watch?v=4jI9PHE6PQk*** or by scanning the QR code below.

## Personal Protective Equipment Regulations

Dave Cooper has drawn attention to the fact that the Personal Protective Equipment Regulations have been updated and a 2022 version has been published. A copy can be found here.

***https://www.hse.gov.uk/ppe/ppe-regulations-2022.htm*** by scanning the QR code below.

The amended regulations extend employers' and employees' duties regarding personal protective equipment (PPE) to limb (b) workers. Limb (b) describes workers who generally have a more casual employment relationship and work under a contract for service.

# REPORT FROM CIBSE SEMINAR

CIBSE Lifts Group held a seminar on the 7th June 2022 in Manchester. Dave Cooper, Managing Director of UK based lift consultants LECS (UK) Ltd, gave us a round up of all that was presented and discussed at the event.

I have the great pleasure of attending many events and very often I come away thinking just how worthwhile they were. The CIBSE Lifts Group Meeting in Manchester on 7th June 2022 was one of those.

I made the trip up from London, having seen the agenda and knowing that the topics covered were so relevant to what is going on in our industry at the moment. I was also delighted to present the CIBSE President's message for the year.

There were two main themes – evacuation lifts and professional competence. Nick Mellor spoke about the standards affecting evacuation lifts and explained the relevance of BS9999, BS9991 and the situation with EN81-76. He also looked at the various methods for evacuation under discussion. This was superbly complemented by Adam Scott who discussed the London Plan and how this has evolved, is still evolving and likely to affect other areas of the UK. Dr Gina Barney presented a very interesting paper about how the RTT formula can be adapted to evacuation lifts and their sizing. Three super papers that complemented each other so well. Starter, main course and sweet – I will leave you to decide which was which.

I had the pleasure of a few minutes on the rostrum after Michael Bottomley opened proceedings, to deliver the CIBSE President's message and to advise that the Building Safety Act was now on the statute books and professional competence within our industry was under scrutiny. Phil Pearson complemented this with a paper setting out his journey to becoming a Chartered Engineer. The message to take away from his paper is that if it's hard, it's worth doing. If I am allowed to let my philosophical head to take over for a minute I would quote the old saying "a person that stands still in a progressing world is really going backwards". Experience is as relevant as academia, we all went away with the message that professional registration is important.

## A superb event in the wonderful surroundings of the Manchester Chamber of Commerce offices.

I opened with my views and I will close with them too. Going south on the train gave me time to ponder even more and the very fact that 36 very senior people in the North West lift industry made the effort to attend, screams out loud that the CIBSE Lifts Group should be congratulated for its efforts not to be London centric. It was a joy to be there, it was educational to be there and I look forward to my next trip up.

Find out more about the CIBSE Lifts Group, visit *www.cibse.org/lifts-group.*

# LETTER FROM AMERICA


The common goal of the AHJs and the Lift industry is safety.

**Reviewing the lift industry from the other side of the Atlantic Ocean, Rory Smith, professor in Engineering/Lift Technology at the University of Northampton, gives us an insight to some of the differences between the US and UK, as well as some of the issues with a lack of national code.**

**The USA is a large country, however you may be surprised about the dimensions of the lift market:**

The surface area of the US is **39.3** times the area of the UK, but the population of the US is only **4.9** times that of the UK, and the number of lifts installed is only **3.3** times that of the UK.

The US has large areas that are uninhabited. I live in suburban Las Vegas, however 2km from my home, the population density drops to less than one person per square kilometre. The population density of scorpions and rattlesnakes is, of course, much higher.

### THERE ARE THREE INTERESTING CHARACTERISTICS OF THE USA LIFT MARKET:

1. A single standard such as BS EN 81-20:2014 does not exist.

2. Eighty percent of the field workforce is represented by a labour union.

3. The most common lift currently being installed serves two landings and has a capacity of almost 1,000 kilograms.

## UNDERSTANDING THE LACK OF A NATIONAL CODE

When the original 13 US colonies became independent from the UK, they viewed themselves as 13 independent countries (states). Even now, over 200 years later and with 50 states, each state has a high level of independence from the national government. As a result, most states have their own lift code and lift authority, known as AHJs (Authority Having Jurisdiction). There are over 100 AHJs in America.

There is no true national code in the USA, all AHJs use a form of the ASME A17.1 code, either the 2002, 2004, 2007, 2010, 2013, 2016 or 2019 edition, and each add modifications to the base code. The states of Michigan and city of Detroit are good examples of this code issue.

The State of Michigan uses the 2010 edition of the ASME A17.1 code. The City of Detroit, the best-known city in Michigan, uses the City of Detroit Code - the 2010 edition with some modifications. With so many AHJs and so many variations of the A17.1 code, things can get confusing.

Imagine having two projects near each other on the same street. You use one code book on the north side of the street and a different code book on the south side of the street because the north side of the street is not within the city limits.

The common goal of the AHJs and the lift industry is safety. However, the continuous introduction of innovative technologies at times needs explanation. The **NEII** can be very helpful in this area. They work closely with AHJs to maintain good working relationships with the lift industry.

In the US there are many organisations that represent various segments of the lift industry.

### ASME

**American Society of Mechanical Engineers.** Responsible for producing, publishing, and maintaining the Elevator and Escalator codes.

### IAEC

**International Association of Elevator Consultants.** The members of this organisation are lift consultants.

### IUEC

**International Union of Elevator Constructors.** A labour union representing approximately 80% of the lift engineers who install, repair, service or modernise lifts in the USA and Canada.

### NAEC

**National Association of Elevator Contractors.** Representing component and parts suppliers as well as independent lift contractors.

### NAESA

**National Association of Elevator Safety Authorities.** Representing the lift and escalator inspection community. Offering training and testing of qualified individuals so that they can become a Qualified Elevator Inspector (QEI).

### NEII

**National Elevator Industry Incorporated.** An advocacy organisation that represents approximately 80% of the lift industry to government bodies.


## RORY SMITH

Rory Smith is Visiting Professor in Engineering/Lift Technology at the University of Northampton. He has over 53 years of lift industry experience during which he held positions in research and development, manufacturing, installation, service, modernization, and sales. His areas of special interest are Robotics, Machine Learning, Traffic Analysis, dispatching algorithms, and ride quality. Numerous patents have been awarded for his work.


# ELEVATOR PITCH

**The lift industry is full of people with fascinating stories, so our Elevator Pitch is a chance to share a journey in a lift and find out a little bit more about them.**

Today we're heading up 72 floors to take in the view from the Shard, in London. At six metres per second, we'll be transported 310m to the top in no time. Our guest had better talk fast! The doors open to reveal Matt Appleby, Apprentice Software Developer at Peters Research.

**DOORS CLOSING… GOING UP…**

**TELL ME ABOUT YOUR JOB - WHAT DO YOU DO?!**

I'm part of team that make simulations for modelling buildings' lift requirements to ensure they are not over or under provisioned.

**YOU'RE AN APPRENTICE - WHY DID YOU CHOOSE TO TAKE THIS PATH?**

I wanted to get out of full time education as quickly as possible, and spent a year working here before I decided I wanted to commit to getting qualified. Being able to continue in the job and study at the same time was a win win situation.

I'm part of team that make simulations for modelling buildings' lift requirements to ensure they are not over or under provisioned.

**WHAT'S THE BEST THING ABOUT YOUR JOB?**
The flexibility is incredible - in terms of both time and workloads. I'm able to work flexible hours and have time to focus on the other interests in my life. Also, if I have multiple projects on the go, I can dip in and out, choosing whether I want to do some coding, research, admin, or take the bins out, depending on what I feel like on the day!

**WHAT DO YOU LOVE ABOUT LIFTS?**
I think what I love about the lift world is that it's a really niche industry, with a huge opportunity to become the best in your field.

**WHAT'S YOUR FAVOURITE THING TO DO OUTSIDE OF WORK?**
Music. I write songs inspired by philosophical concepts and create music videos for YouTube. It's the thing that keeps me sane!

**IF YOU COULD BE A FICTIONAL CHARACTER, WHICH ONE WOULD IT BE AND WHY?**
Orpheus is a fascinating character from Greek mythology. They had superhuman musical skill and showed the power of artistic expression, without violence. If some say that the pen is mightier than the sword, I like to think that Orpheus showed the lyre to be mightier still!

**IF YOU COULD ONLY EAT ONE THING FOR THE REST OF YOUR LIFE, WHAT WOULD IT BE?**
Chickpeas are really versatile, you can make a humous, falafel, curry… the possibilities are endless!

**Picture credits:**

Ian Branch

Noah Banfield
*www.instagram.com/noahbanfield1999/*

**IF YOU WERE STRANDED ON A DESERT ISLAND WITH ENOUGH FOOD AND DRINK, WHAT ARE THE TWO THINGS YOU'D WANT WITH YOU?**
My guitar and laptop - assuming there was some power source - I'm sure we could create some solar power on the island!

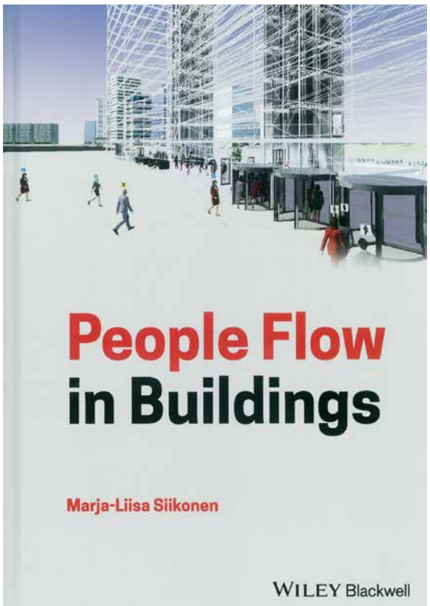
And with that, we've reached our destination. Shall we visit the open air skydeck, grab a cocktail or play the piano in the sky?! Maybe we'll just take in some of the incredible city views…

If you'd like to hear some of Matt's music, visit his website -

*mappleby.uk* - or find him on YouTube - *youtube.com/c/MapplebyMusic*

# THE BOOK CLUB

**People Flow in Buildings**
by Marja-Liisa Siikonen
**Reviewed by Richard Peters**



I am proud to have her as a friend, even if we occasionally have technical disagreements!

### INTRODUCTION

Dr Marja-Liisa Siikonen is a well-known and highly respected expert in the science of people flow. We first met in the late 1980s when she worked at Kone, and I worked at Arup. We have continued our conversation for over 30 years at conferences, working together on projects, and at standards meetings. I am proud to have her as a friend, even if we occasionally have technical disagreements!

In their book description, the publisher, Wiley Blacker, explains that People Flow in Buildings is perfect for software designers in the private sector and academia, appealing also to lift consultants, manufacturers, and architects. It is a valuable record of Marja-Liisa's substantial research and experience. The book explains how modern trends in building usage have affected how people use buildings. It was written during the Covid-19 pandemic and acknowledges the unknowns of the "new normal", which is a live discussion among practitioners in this area. The key topics covered are measurement, control, modelling, and planning. The book is divided into five parts as follows.

### PART I MEASURED PEOPLE FLOW IN BUILDINGS

One of the significant challenges for lift designers is measuring traffic. Marja-Liisa describes people counting techniques and how the measurements can be modelled using a Poisson process. She also addresses passenger batches, which helps us to consider the implications of people travelling in groups rather than alone. Marja-Liisa's work with batches was pioneering, and other researchers, including my work colleagues, have followed on from this work with our modelling proposals. The industry needs data on observed batch sizes to apply batching in simulation. Marja-Liisa provides this on page 35 in Table 3.4, which will be something I reference – thank you, Marja-Liisa.

In 2000 Marja-Liisa published a paper, On Traffic Planning Methodology, where I first saw the description of traffic in terms of incoming, outgoing, and interfloor components. This description of traffic, e.g., 45% incoming, 45% outgoing, and 10% interfloor, is now commonly referred to as a traffic mix. She presented an all-day traffic profile for an office building as a stacked area graph as opposed to how it had been traditionally presented, as up and down traffic, by Strakosch in The Vertical Transportation Handbook (1983). I found this novel presentation of traffic insightful in 2000 and have used it ever since. In People Flow in Buildings, Marja-Liisa provides a wealth of traffic measurements in this and other formats, which will be of value to practitioners seeking to model traffic in buildings beyond designing to benchmark handling capacities and passenger demand profiles.

### PART II PEOPLE FLOW SOLUTIONS

Marja-Liisa provides a historical discussion of dispatching, i.e., the traffic control system that decides which lift services each call. She discusses basic and intelligent dispatching, control system architectures, artificial intelligence, optimisation objective functions and destination control. The content will benefit students considering dispatcher design and provide insights for practitioners who need to answer their clients' questions on these topics. Marja-Liisa continues the discussion to address double deck lifts and the TWIN and MULTI solutions offered by TK Elevator.

She concludes this section with a discussion of architectural considerations, including layouts, dimensions, lobby arrangements, doors, and staircases.

### PART III PEOPLE FLOW CALCULATION METHODS

In this part, Marja-Liisa introduces the critical parameters needed for calculation and then dives into the maths, which is essential for software designers and academics. Only specialists will consider the complex formulae. However, it is valuable to have documented the mathematical basis of the software where it has been implemented.

Marja-Liisa considers the space required for circulation and how many people you can get in a lift. She provides helpful tables and formulae to calculate the handling capacity of walkways, staircases, escalators, corridors, doorways, revolving doors, turnstiles, and ticket counters. Finally, she considers calculating how many touchscreen destination operation panels are required when applying destination control.

### PART IV PEOPLE FLOW SIMULATION METHODS

Marja-Liisa discusses the history of the development of simulation methods, and a range of simulation methodologies ranging from Monte Carlo Simulation, through Traffic Simulation of an Elevator Group, to Building Traffic Simulation, where horizontal as well as vertical movement is considered. In her discussion of simulation procedures, Marja-Liisa introduces traffic patterns, including the templates offered by CIBSE Guide D Transportation Systems in Buildings 2020 and ISO 8100-32:2020, to support the modelling of offices, hotels, and residential buildings. She proposes an approach to validating simulation software, a topic that is becoming increasingly important as practitioners rely more on simulation.

Marja-Liisa goes on to demonstrate the performance of a range of systems for increasing levels of passenger demand. She explains the up-peak boost seen with destination control, exploring up peak, lunchtime and down peak performance.

### PART V PEOPLE FLOW PLANNING AND EVACUATION

Having addressed measuring passenger traffic, modelling techniques and control systems, this section of the book addresses their application. Marja-Liisa provides a detailed discussion of ISO 8100-32:2020 Part 32 Planning and selection of passenger lifts to be installed in office, hotel and residential buildings, written by ISO Working Group 6, Sub Group 5, which she chaired.

She addresses the zoning of lifts for high-rise buildings, double-deck lifts, shuttle lifts and sky lobbies and the implications of core space according to different lift arrangements.

Evacuation using lifts is becoming increasingly important. Marja-Liisa introduces egress time calculations, fire and non-fire modes, and evacuation strategies, including total, staged and fractional. She discusses the evacuation strategies applied in some of the world's tallest buildings.

### IN CONCLUSION

On my "lift bookshelf", I have Pedestrian Planning and Design (Fruin), The Elevator Traffic Handbook (Barney and Al-Sharif), The Vertical Transportation Handbook (editors Strakosch and Caporale) and CIBSE Guide D Transportation Systems in Buildings (editor Barney). I shall be adding People Flow in Buildings (Siikonen) to that shelf. Marja-Liisa has made a significant contribution to the science of lift traffic analysis and simulation; to have a synopsis of her work summarised in this book is a gift to our industry. Some of it will only be of interest to software designers and academia. But I agree with the publisher that there is also valuable content for lift consultants, manufacturers, and architects. If that is you, I suggest you buy a copy to add to your bookshelf.

Richard Peters has a degree in Electrical Engineering and a Doctorate for research in Vertical Transportation. He is a director of Peters Research Ltd and a Visiting Professor at the University of Northampton. He has been awarded Fellowship of the Institution of Engineering and Technology and of the Chartered Institution of Building Services Engineers. Dr Peters is the author of Elevate, elevator traffic analysis and simulation software.

# LETTERS FROM THE PIT

John is Lift Industry News' very own agony uncle and is here to support you when your vertical transportation relationship is going through a bad patch.
**WISH TO ASK JOHN A QUESTION »**
*www.liftindustrynews.com/dearjohn* or scan the QR code.

### "WHY IS 25 SECONDS A REASONABLE WAIT TIME?"

Sheila, a consultant, working for a major Mechanical & Electrical company in London, challenges perceived wisdom.

### DEAR JOHN

Why is a 25 second waiting time deemed a reasonable target time to wait for a lift to arrive in my company's HQ when I now work from home three days a week and rarely arrive at my office before 9.30 am?

### JOHN SAYS

Firstly, for our Northern readers, let me explain that London is a large city in the South of England which you will hear a lot about from lift industry 'professionals'.

It's an excellent question Sheila, and one I have pondered for some time. Anecdotally I believe the 25s rule may go back to Dr Barney's original research resulting in the famed RTT (round trip time) formula, which many of us know so well. However, I concede I am probably wrong in my assumptions. My understanding is that the waiting time might have been linked to the loss of productive time (£'s per minute) of officers waiting for lifts in HM government buildings. The design rule attempted to reduce such wanton wastage in the latter part of the 20th century. Skip through to 2022 when many of us waste time queuing for over-priced dishwater in tax dodging coffee outlets or stood in airport queues, or simply watching a whirling circle on a computer screen, we all wait for something many times a day. Is a 25s waiting time for a lift realistic in today's world?

The point I am attempting to make is that the 25s at Morning Uppeak rule results in more lifts in buildings. A revised waiting time of 40s throughout the whole working day of a building (which may now be 8.00am to 8.00pm) should result in fewer lifts. The reduced core size could allow for larger lobbies and reduce crowding (should it ever occur for events etc.). Could BCO/CIBSE revise their recommendations? Fewer lifts assist not only in reducing overall power usage for the finished lift system but also contribute to reducing the whole production process and delivery's carbon footprint, up to and including future disposals and replacement.

Given the fundamental global changes in work patterns, building design, staffing levels and an emerging working from home culture, should we not open up the debate and modernise our approach to what amounts to a genuine first world problem? I propose 40s any time of the day is long enough and short enough to keep everyone happy. It may also increase short rise stair usage which in turn makes for a healthier lifestyle; the benefits are endless!

## "WHY DO WE HAVE ALL THESE SILLY REGULATIONS?"

David, a property owner from Manchester is frustrated that his oak door has been spoilt by a lift safety sign.

### DEAR JOHN

I own an office building with a hydraulic lift. Apparently, no one can go into the room with the hydraulic tank and locked control panel unless they are trained. There are no moving parts. The lift company has put an ugly danger sticker on the lovely oak door. My consultant suggested that I could put a wire cage around the lift equipment so that the room could also be used for other purposes. Frankly, the lift equipment is less dangerous than the electric hob we have in the kitchen! Why do we have all these silly regulations?

### JOHN SAYS

I am a big fan of oak doors and agree they should not be spoilt by ugly and, in my opinion, unnecessary sticky signage. Remove it, keep the door locked and keep the key with a responsible person in your office. Write into your management system that the key should only be issued to qualified personnel on production of their risk assessment for working on or around hydraulic lifts and live control systems. Problem solved.

I had a client with the same dilemma you describe. He asked me what the penalty was for not having a 'DANGER LIFT MACHINERY' sticker on a machine room door in a very nice hotel lobby. I suggested it may result in a letter from local EHO or similar if the LOLER inspector reported it as a defect. He decided to take the risk and declined the sticker. To my current knowledge, the door remains unmarked some 12 years later. The key is in the maintenance manager's office, and the maintenance company knows where it is.

Regarding a wire cage to partition off the hydraulic equipment - the valve block, and outlet pipe could be damaged or interfered with by others, so it may be prudent to add some additional protection if the room is to be used for storage, etc. But again, provided the room is only accessible to authorised persons and managed correctly, a simple cover (mesh or otherwise) over the tank, valve block, and any exposed pipework should solve the problem. This seems to be one of those instances whereby one of those 'chancer type' lift consultants may have half a point.

Concerning 'silly regulations,' I would be happy to expand this column and respond to any of our readers who encounter regulations that seem to be unnecessary or unfathomable. Any thoughts on rubber mats meant to protect engineers? I have some I could share… but maybe that's for next time!

### JOHN BENTLEY

John is an established professional within the lift industry, with over 42 years of varied management and technical experience with a specific interest in quality service delivery, sympathetic lift modernisations where viable, and the development and adaptation of modern technology and design installed in existing environments.

His career started with H&C Lifts/Dover Elevators (USA) and in 1998 he established his own contracting business, trading as ANSA Elevators Ltd. – now recognised as one of the leading independent lift engineering companies in the UK. Since 2015 he has been part owner of LECS (UK) Ltd employed as a Director and Project Engineer covering all aspects of building transportation design and maintenance. He provides the company with all lift traffic analysis support along with expert witness information gathering and reporting.

John believes you never stop learning, so is currently studying Lift Engineering at the University of Northampton.

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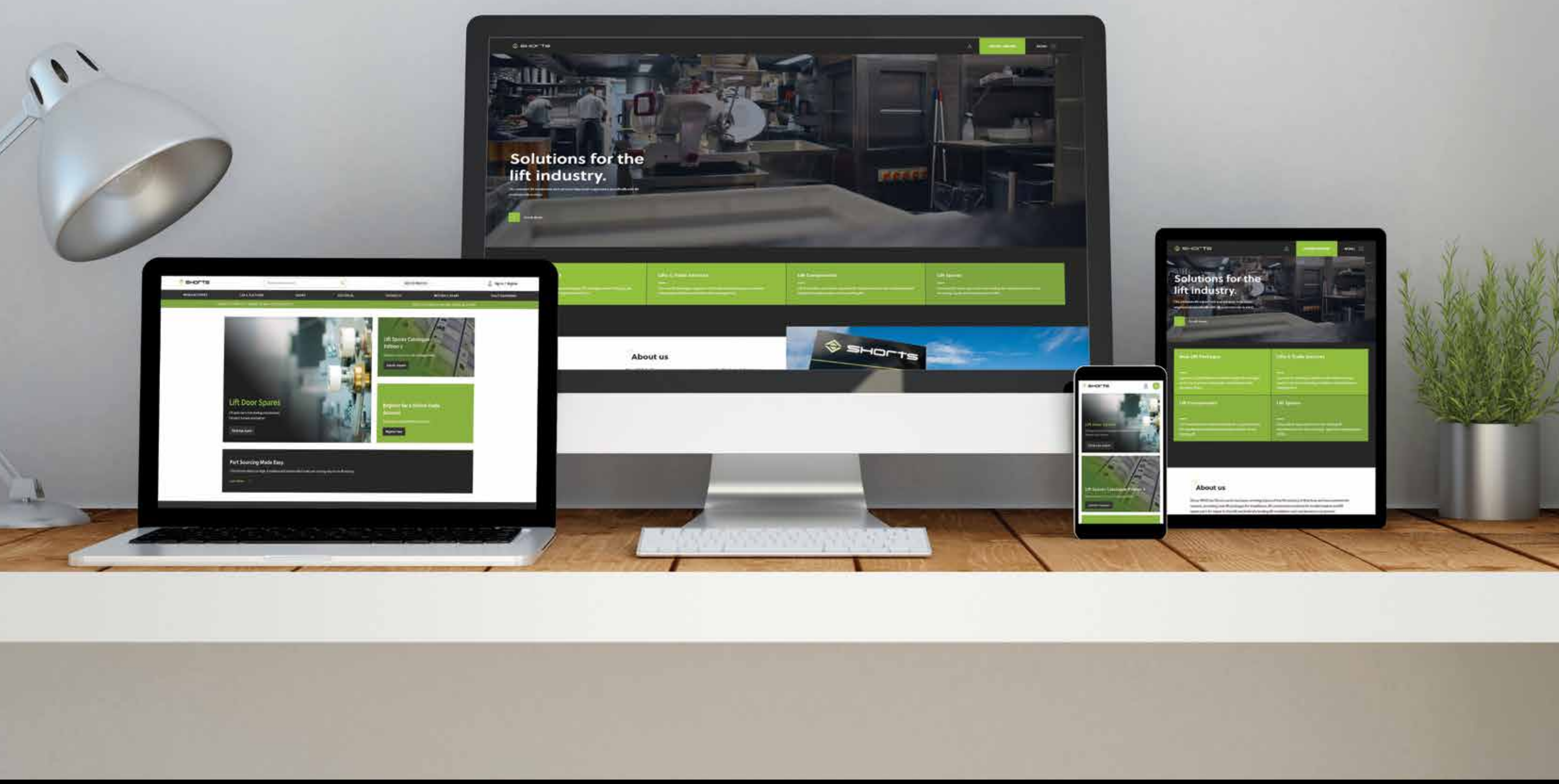


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