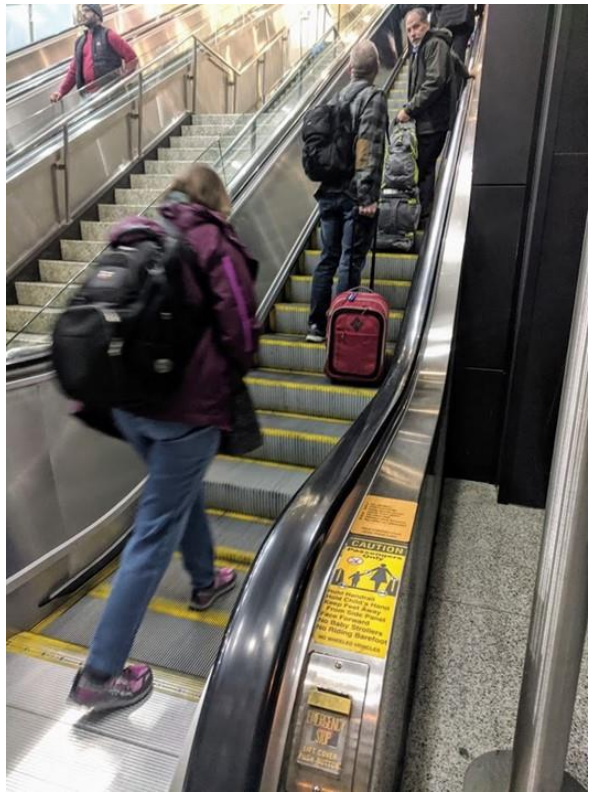


Escalator Falls

ACRP 11-03/Topic S04-25

K.M. Hunter-Zaworski, Ph.D., P.E.(OR)

ACI- Risk Management Conference

OUTLINE

1. Introduction to Project
2. Overview of Escalator Safety-Risk Management
3. Current Practices (Summary of Survey)
4. Effective Practices
5. Summary
6. Future Research Studies

Introduction

- Purpose:
  - to identify and describe methods to mitigate risks from escalator usage
- Target audience:
  - airport operators
    - planning and engineering groups, marketing, customer experience, and revenue/advertising, safety and risk managers, maintenance
  - designers, architects, and consultants
  - airport management companies and building operators
  - insurance carriers and brokers
  - escalator manufacturers

Project Activities

- Review of Literature
- Surveys
- Interviews
- Incident data review
- Synthesis of Results

Escalator Incidents

- Airport and Mass Transit
- Human behavior
- Demographics
  - Small children and elderly
- Health Impacts
- Baggage Fees
- Distractions
  - Cell Phones
- Direction of travel
- Entrapment

Why Mass Transit Literature and Data?

- Similarities
  - Crowding
  - Rushed Conditions
  - Baggage

- Differences
  - More and heavier baggage
  - First-time users versus regular commuters
  - Airports have a more diverse demographic

Human Behavior

- Lack of situational awareness
- Inattention
- Lack of attention to risks of “moving stairs”
- Lack of traveler understanding of risks associated with
  - Traveling with large or heavy baggage
  - Soft soled shoes or loose clothing
  - Accompanying children or animals
- Aging impacts on visual acuity

Incident Characteristics

- More females than males
- Older travelers (65+) at greater risk
- More common on “up” escalator
- Backward falls lead to more serious injuries
- Heavy, large, or excessive baggage
- Entrapment
  - Children
  - Animals
- Mobility devices and strollers

Health Impacts

- Air terminal anxiety (Low and Chan, 2002)
- Incident reports
  - Light-headedness
  - Dizziness
- Physiological impacts of flying
  - Dehydration
  - Dizziness

“58 or more airports use therapy dogs to reduce passenger stress”

Direction of travel

- Right handed versus left handed direction-of-travel assumptions
  - Leads to attempted entry at improper end of escalator
  - Contributes to congestion at escalator exits

Entrapment

- Loose clothing
  - long dresses, scarves, etc.
- Shoelaces
- Soft-soled shoes
  - flip-flops, rubber boots, Crocs™, etc.
- Stiletto heels
- Children’s extremities

(Williams and Sevenants, 2015)

(Williams and Sevenants, 2015)

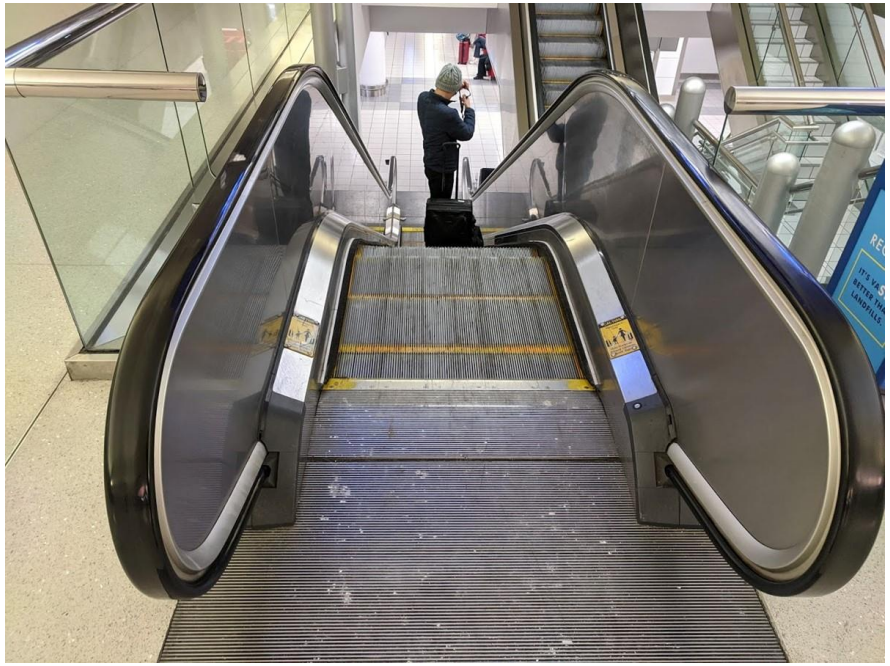
Additional Baggage

- Passengers are carrying more bags through terminal
  - Free gate checking of bags

- Extra baggage
  - Prevents passengers from holding escalator handrails
  - Changes passengers' center of balance when bags are on a lower step
  - Loose straps get caught in escalators

Cell Phone Distractions

- Cell phones are a major source of distraction
  - Talking
  - Texting
  - Reading
  - Selfies (and other photography)
- Occupies hands that should be used to hold escalator handrails
- Distracted passengers fail to pay attention to transition zones

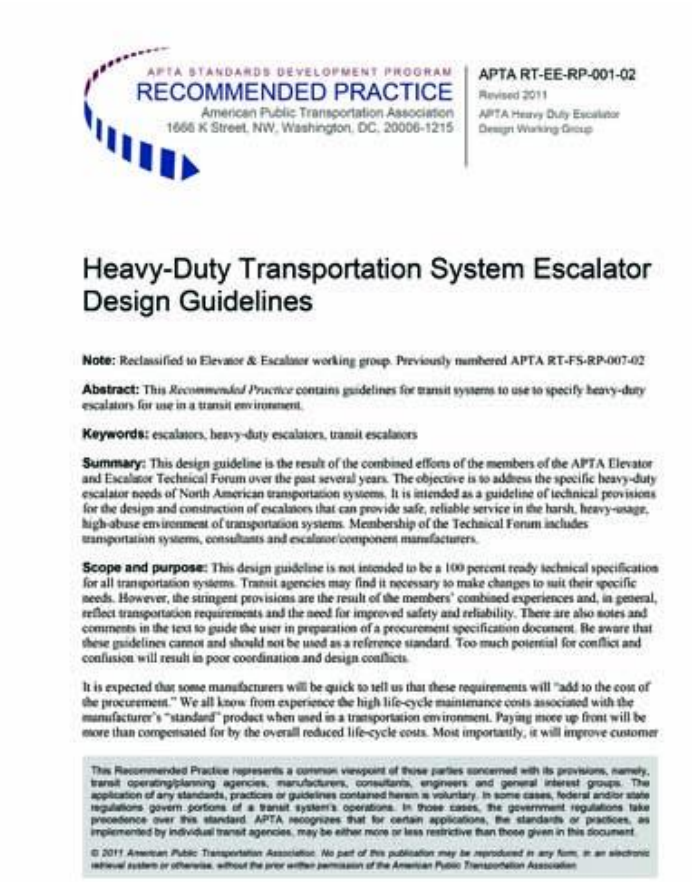


Incident Data—Risk Management

- Escalator incident reporting
  - No consistent reporting format or standards
    - Increases difficulty and cost to conduct objective studies of incidents
  - Working groups should develop
    - Industry wide escalator incident mitigation programs
    - Consistent data analytics methods

Mitigations

- Escalator standards
  - Improved signage requirements
- Escalator design
  - Reduce operating speed
  - Increased step width
  - Three flat steps



APTA STANDARDS DEVELOPMENT PROGRAM
RECOMMENDED PRACTICE
American Public Transportation Association
1666 K Street, NW, Washington, DC, 20006-1215

APTA RT-EE-RP-001-02
Revised 2011
APTA Heavy Duty Escalator Design Working Group

Heavy-Duty Transportation System Escalator Design Guidelines

Note: Reclassified to Elevator & Escalator working group. Previously numbered APTA RT-FS-RP-007-02

Abstract: This *Recommended Practice* contains guidelines for transit systems to use to specify heavy-duty escalators for use in a transit environment.

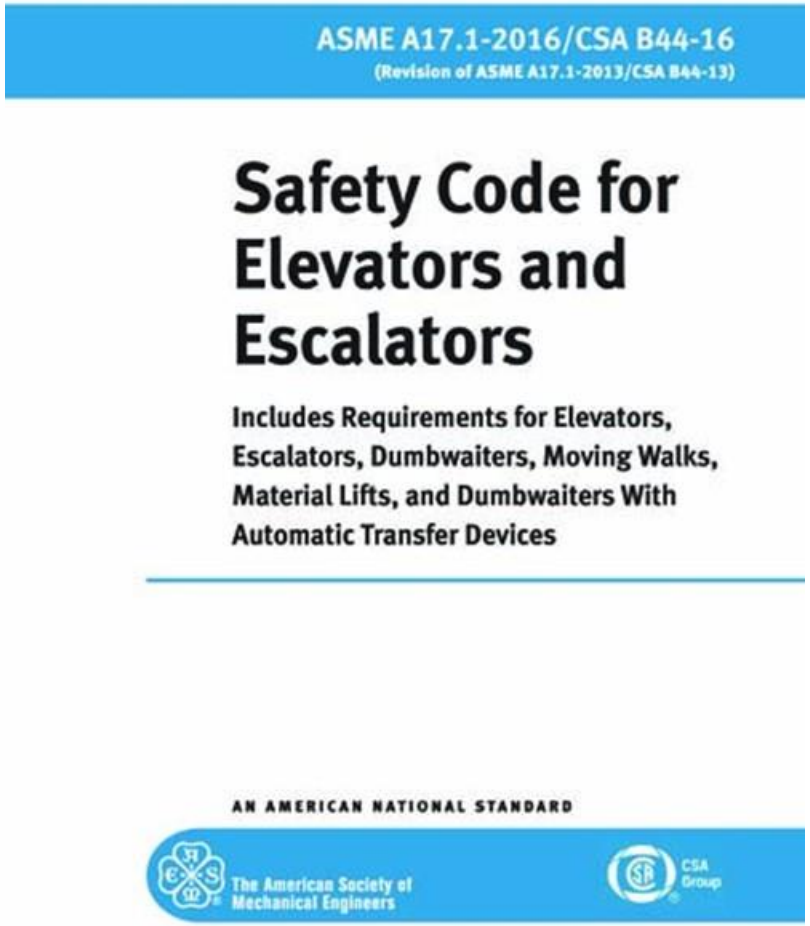
Keywords: escalators, heavy-duty escalators, transit escalators

Summary: This design guideline is the result of the combined efforts of the members of the APTA Elevator and Escalator Technical Forum over the past several years. The objective is to address the specific heavy-duty escalator needs of North American transportation systems. It is intended as a guideline of technical provisions for the design and construction of escalators that can provide safe, reliable service in the harsh, heavy-usage, high-abuse environment of transportation systems. Membership of the Technical Forum includes transportation systems, consultants and escalator/component manufacturers.

Scope and purpose: This design guideline is not intended to be a 100 percent ready technical specification for all transportation systems. Transit agencies may find it necessary to make changes to suit their specific needs. However, the stringent provisions are the result of the members' combined experiences and, in general, reflect transportation requirements and the need for improved safety and reliability. There are also notes and comments in the text to guide the user in preparation of a procurement specification document. Be aware that these guidelines cannot and should not be used as a reference standard. Too much potential for conflict and confusion will result in poor coordination and design conflicts.

It is expected that some manufacturers will be quick to tell us that these requirements will "add to the cost of the procurement." We all know from experience the high life-cycle maintenance costs associated with the manufacturer's "standard" product when used in a transportation environment. Paying more up front will be more than compensated for by the overall reduced life-cycle costs. Most importantly, it will improve customer

This Recommended Practice represents a common viewpoint of those parties concerned with its provisions, namely, transit operating/planning agencies, manufacturers, consultants, engineers and general interest groups. The application of any standards, practices or guidelines contained herein is voluntary. In some cases, federal and/or state regulations govern portions of a transit system's operations. In those cases, the government regulations take precedence over this standard. APTA recognizes that for certain applications, the standards or practices, as implemented by individual transit agencies, may be either more or less restrictive than those given in this document.



ASME A17.1-2016/CSA B44-16
(Revision of ASME A17.1-2013/CSA B44-13)

Safety Code for Elevators and Escalators

Includes Requirements for Elevators, Escalators, Dumbwaiters, Moving Walks, Material Lifts, and Dumbwaiters With Automatic Transfer Devices

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

CSA Group

Escalator Design

- Operating speed
- Capacity
  - Passenger and baggage
- Step width
- Maintenance frequency
- Specifying high quality equipment

Airport Escalator Specification

2.3 ESCALATORS

A. Escalators, General: Manufacturer's standard escalators complying with requirements. Unless otherwise indicated, manufacturer's standard components shall be used, as included in standard escalator systems and as required for complete system.

1. Basis of design: Otis Escalator Model NCE508

B. High-Traffic Escalators, General: Manufacturer's high-traffic escalators complying with requirements. Unless otherwise indicated, manufacturer's heavy-duty components shall be used, as included in standard high-traffic escalator systems and as required for complete system.

C. Design and equip escalators to run in either direction.

D. Provide escalators with three flat steps at top and bottom landings.

E. Rated Speed: 90 fpm.

Airport Design

- Co-locating Vertical Change Elements
  - Stairs
  - Elevators
  - Escalators
- Elevator location
- Wayfinding signage
- Right-hand direction-of-travel
- Congestion
- Remote baggage check-in

Remodel of Terminal 1 –Minneapolis St. Paul Airport

Elevators

“Homed” Elevators

- Green Arrow
- Doors Open

Signage

- No more than three lines of text
- Icons and symbols

Escalator Signage

- Need airport-specific escalator signage
- Balance required and desired information
- Need consistency

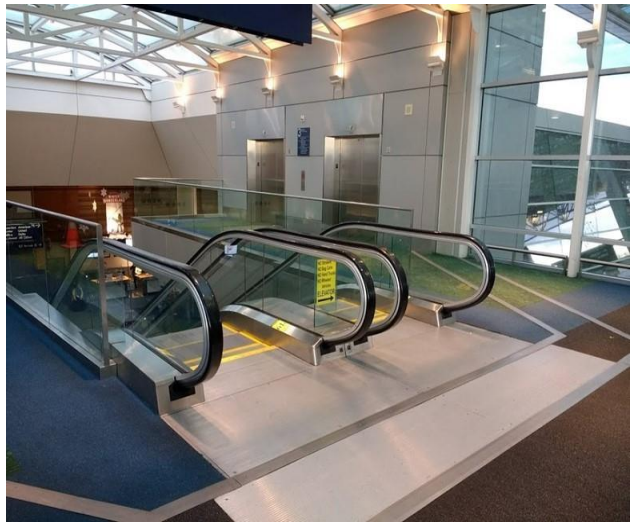
Wayfinding

- Tactile guide lines
  - Direct low vision and blind travelers towards elevators
  - Avoid escalators and stairs

European Airport (Netherlands) (Courtesy of Lukas Franck)

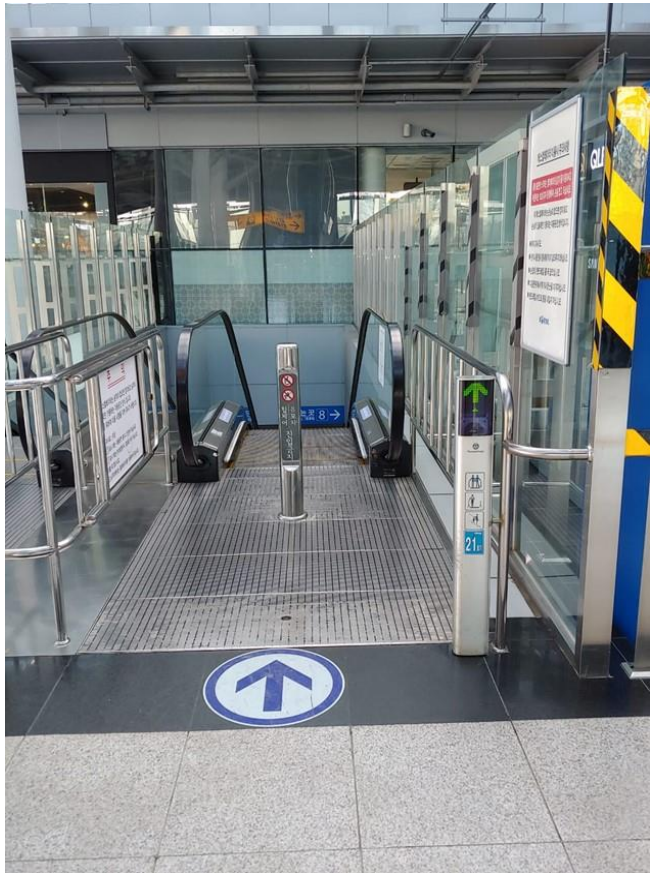
Wayfinding Signage

Where is the elevator?



Congestion and Access Controls

Canadian Airport



Korean Transit Station

Remote Baggage Check

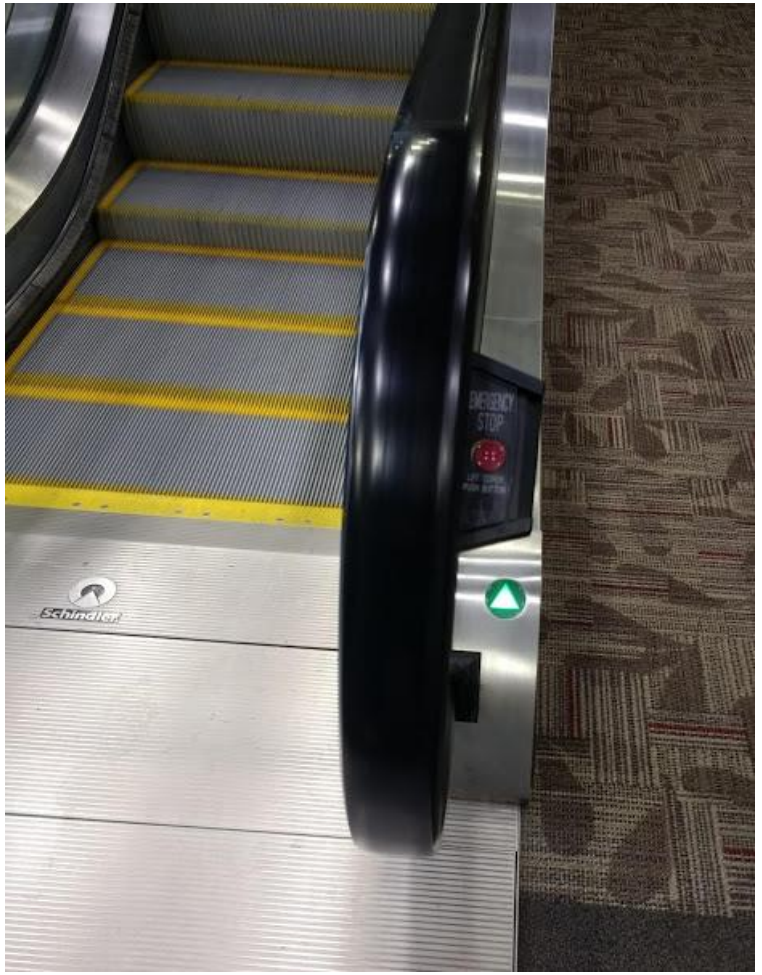
- Easier for passengers
- Reduces congestion on airport train and at check-in
- Reduces number of passengers with baggage on escalators

Operations

- Public Service Programs
- Link for SeaTac Safety video
  - https://www.youtube.com/watch?v=vZixvOH3Eew
- Employee Training

Effective Practices to Manage Escalator Falls

- Reduced operating speed
- Three flat steps at entrance and exit
- Signage on escalator
- Wayfinding signage
- Terminal Design



Discussion

What do you notice?

Tactile floor

Bollards

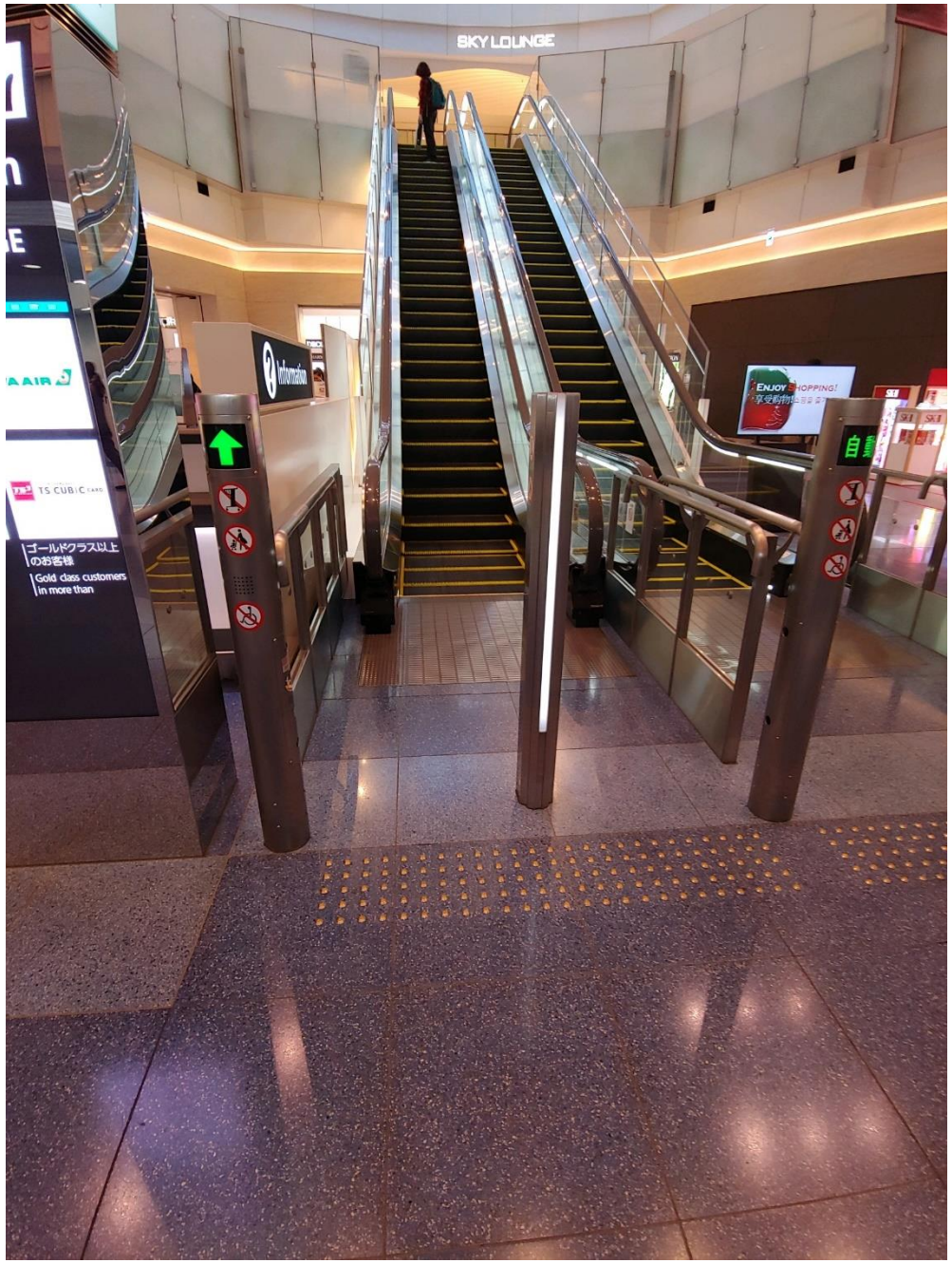
Left Side(Japan)

Green Arrow

Use of Icons

Transition Zones

Three Flat Steps



Talking Escalator at Haneda Airport Tokyo (Courtesy of Harry Saporta)

Research gaps

- Optimum escalator operating speed
- Standardized escalator signage for airport escalators
- Effectiveness of homing elevators
- Impact of remote baggage check-in on escalator incidents
- Impact of baggage fees on escalator incidents
- Physiological impacts of flying

What can ACI Committees do?

- Recommend slower speed for escalators (90 fpm or slower)
- Develop airport specific escalator signage that meets national and state requirements
- Develop clear wayfinding signage and locate elevators on main path of travel
- Other activities
- Investigate remote baggage drop off and impact of baggage fees