Effect of Innovative Stair Design on Physical Activity

Evaluating Skip-stop Elevators and Stairs in the Caltrans District 7 Headquarters Building, Los Angeles, California

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Stair climbing for exercise alone is largely limited to those capable of athletic training.

Increasing the frequency of stair use in the workplace is a great potential to augment the physical activity of most working adults.

Stairs have been primarily relegated to the ancillary role of emergency egress.
Strategies for Promoting Physical Activity

Pull strategies

passive informative, motivational or environmental efforts, voluntarily use stairs;

Push strategies

social programming, or environmental interventions designed to mandate new behaviors.
Strategies for Promoting Physical Activity

Pull strategies

- Behavioral Change or Lifestyle Modification
- Environmental Enhancement & Restructuring
- Motivational signage
- Upgrade interior finishes

Before & After images of a staircase:
- BEFORE
- AFTER

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Strategies for Promoting Physical Activity

Pull strategies

Locating stairs where people are most likely to use them instead of the elevator

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Strategies for Promoting Physical Activity

Push strategies

Provision of Skip-stop Elevators and Adjacent Open Staircases at the Caltrans District 7 Headquarters Building, Los Angeles, California
Caltrans District 7 Headquarters Building

Traditional Elevator Core

Skip-stop Elevator Core with adjacent stairs

Skip-stop elevators stop only on floors 1, 4, 7, 10, and 13.

Skip-stop stairs offer access to the floor above and one floor below.

Section through Building
The Caltrans building provides a natural experiment for the investigation of the skip stop elevator/stair arrangement.

5th Floor Plan

- Skip Stop Stairs
- ADA Compliant Elevator
- Traditional Elevators
- Skip Stop Elevators [they do not stop at this floor]

Traditional Vertical Circulation Core

Skip-stop Vertical Circulation Core
Design of Objectives for providing the Skip-stop Elevators & Staircase

1. Organize this high-rise building into a more human scale

2. Increase personal interaction and overall office cohesion among Caltrans employees

3. Increase physical activity while decreasing non-productive time spent waiting for elevators.
Key Research Questions

1. Is there a difference in stair use patterns between the two vertical circulation cores in the Caltrans District 7 Headquarters Building?

2. How has the provision of this new skip-stop vertical circulation arrangement affected employee attitudes and behaviours towards workplace satisfaction and physical activity?

3. What implementation issues related to the provision of a skip-stop vertical circulation core in the Caltrans District 7 Headquarters Building that should be considered in applying this strategy to other buildings?
Data Collection Method: Stair Use

Record stair use in the two types of vertical circulation cores

- Stair use on open staircases adjacent to skip-stop elevators measured with active infrared monitors
- Stair use on the enclosed fire stairs measured using monitored access card reader system

Measurement period: 24 weeks
Data Collection Method: Employee Behaviour, Attitudes & Perceptions

Online self-report survey

Self-reported measure of change in employee behaviors and attitudes towards physical activity and stair use.
Questions adapted from IPAQ (International Physical Activity Questionnaire)

Self-reported measure of change in employee’s change in attitudes & perceptions towards the new Caltrans Building and the skip-stop elevator/stair arrangement, changes in work patterns and movement in relation to their previous building.
Questions adapted from the Occupant Satisfaction Survey (Huizenga, Zagreus et al. 2003)
Data Collection Method: Skip Stop Elevator Implementation Issues

Interviews with key decision makers on issues related to the implementation of the skip-stop elevators/stairs arrangements in the Caltrans building.

Site Visit & Assessment

Interviews with
Client – Chief Administrator
Client- Health & Safety Officer
Project Architect
Cost Consultant
Elevator Technical Advisor

Building Code Assessment
Results: Comparison of Stair Use

Stair usage during 24 weeks between 4th and 8th floors of Caltrans Building

South fire stair
Daily average usage: 30
Total 24 weeks usage: 3570

North fire stair
Daily average usage: 13
Total 24 weeks usage: 1483

North skip-stop stair
Daily average usage: 980
Total 24 weeks usage: 117,619

Traditional Vertical Circulation Core
Skip-stop Vertical Circulation Core

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Are others averages also? Need to be consistent among these 3

sj90, 7/9/2007
Results: Comparison of Stair Use

Open staircases next to skip stop elevators were used 3300% more than enclosed stairs next to traditional elevators.

- South Fire Stair
- North Fire Stair
- Skip-stop Stair

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Results: **Online self-report survey**

17% response rate (299/1718)

Demographics similar to Caltrans population
- 70% male,
- 90% bachelor degree or higher
- 33.6% White, 34.6% Asian
- 53% between ages 40 & 54

Physical Activity Levels (PA)

- 27.8% reported that they did not achieve minimum recommended level of PA any day

- Only 26.4% reported achieving recommended minimum levels of PA daily
Results: Comparison of Employee Attitudes & Perceptions

72% of Caltrans District 7 Headquarters Building employees reported daily use of stairs.

50% reported 1-6 flights per day
Average stair use 2 flights per day
The use of the skip-stop elevator/stair can be accepted and even embraced by the majority of employees over time.
Results: Comparison of Employee Attitudes & Perceptions

Four principal reasons for increases in stair use reflect both Push & Pull strategies

- 26.70% Work responsibilities made it necessary
- 14.70% No available elevator nearby
- 28.00% More convenient than waiting for the elevator
- 22.60% People enjoyed the health benefit of increased stair use

Push

Pull
Results: Relationship between Stair Use & Employee Behaviors, Attitudes & Perceptions

Stair Use & Workplace Attitudes

The employee’s perception of office cohesion was inversely correlated with the greater number of flights \( (R^2=0.061, p=0.0013) \).

The satisfaction with the skip-stop arrangement was negatively influenced by the greater number of flights \( (R^2=0.0385, p=0.001) \).
Results: Relationship between Stair Use & Employee Behaviors, Attitudes & Perceptions

Stair use not related to “Natural Selection” of more physically-minded individuals.

No relationship between amount of stair use &:
- location of workstations
- demographic variables
- physical activity levels

Only minor relationships between stair use &:
- Preference to take stairs $R^2=0.03$ (p=0.002)
- Preference to take lunchtime walks $R^2=0.024$ (p=0.007)
Results: Skip Stop Elevator Implementation Issues

1) Compatibility with the Organizational Structure
   • The Caltrans building is a single tenant building with multi-departmental organization interaction between departments.

Most office buildings have multiple tenants with limited interaction between building occupants on other floors.

Would users of buildings without multi-level interaction benefit from this design strategy?
Results: Skip Stop Elevator Implementation Issues

Building Code Issues

Fire stairs are enclosed with a 1-hour fire-rated separation construction assembly;

Open skip stop staircases are not fire exits

Architects received a variance from building officials to use open skip-stop stairs interconnect three-story units by using additional sprinklers to create a wall of water in case of fire.
Results: Skip Stop Elevator Implementation Issues

3) Cost Implications

The may be minimal differences in capital costs between skip-stop stairs/elevators and traditional elevator arrangements.

Cost benefits of 72% employee stair use can not be assessed at this time.
Results: Skip Stop Elevator Implementation Issues

4) Security Issues

The Caltrans building controls public access to the building at the entry lobby where visitors sign in/out.

This security measure may be incompatible with many other government and corporate buildings.
5) Health and Safety Considerations

Although stair use can increase risk of injury from falls, only 1 stair injury had been reported.

There was an initial influx of requests and verifications for designated status allowing the use of the ADA elevator.
Thank you