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Photoluminescent marking study: update and future work

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Photoluminescent Marking Study: Update and Future Work

Guyl ne Proulx, Ph.D.

National Research Council Canada | Conseil national de recherches Canada | Canada

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Presentation Outline

- Study objectives
- Bui ding
- Photolu l escent installation
- Procedu e
- Results
- Conclusio s
- Future s udies

Slide 2

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Study Objectives

- To assess the effectiveness of various instal ations of photoluminescent material as waygūidance systems for use during building evacuations;
- To compare the effectiveness of a photolu nescent waygūidance system to an environment under emergency lighting condition;
- To develop an installation guide for Canadi n federal government highrise office buildings.

Slide 3

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Building Selection

- Highrise office building
- 4 geometrically identical windowless stairwells
- Proactive management and supportive staff
- Conduct an annual evacuation drill that we could monitor

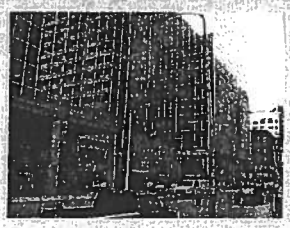


Slide 4

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C D. Howe Buildi g 240 Sparks St, Ottawa

- Building built in 1977
- Occ p es a w ole city block
- 13-storey
- Office floor of 8,000 m² mix of open and closed plan offices
- Housing around 4,000 occupants

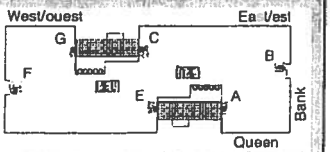


Slide 5

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The Study

- Use the 4 windowless stairwells A, C, E, G
- Put up 3 different PLM installations
- 4 stairwells existed at street level



Slide 6

Photoluminescent Material Installation

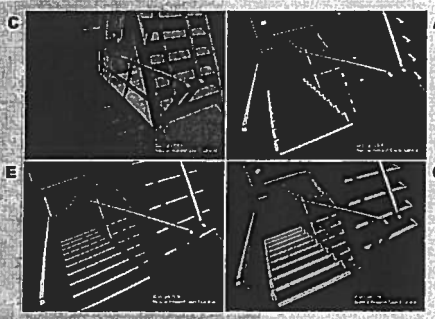
In accordance with the research team request three companies supplied and installed the material:

- Prolink North America
- Jessup Manufacturing Company
- Jalite USA
- All material met NYC LL26 and MEA certification (BR 30, 735)



Slide 7

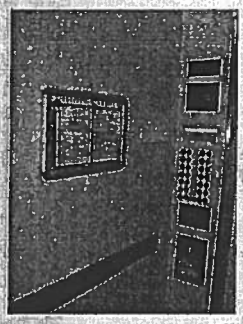
Four Studied Stairwells



Slide 8

Procedure

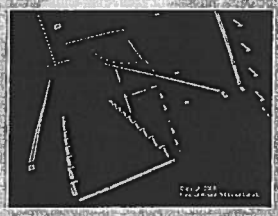
- Ethics issues and consent
- Occupants information
  - E-mail
  - Information sheet in elevator
- Briefings:
  - Management
  - Building Emergency Organization
  - Floor Emergency Officers briefing



Slide 9

Pre-Test

- Installation completed one week prior to the drill
- Pre-test with management and representatives of the BEO
- Concern over Stairwell A particularly with the last step
- Add 3 firefighters and 3 civilians during the drill to assist the occupants



Slide 1

Support to the Drill

- Ottawa Fire service on location
- Ottawa police closed Queen street
- Ottawa paramedics on location



Slide 11

Excellent Drill Overall

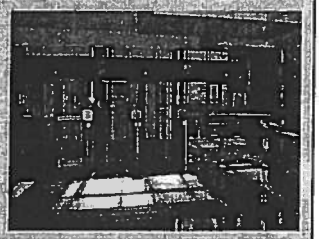
- Evacuation was completed in 11 min 51 s
- Usually drills take around 14 min
- No injury or incident reported
- Debriefing e-mail to occupants



Slide 12

Data Gathered

- Video cameras in the 4 studied stairwells
- Questionnaire distributed to every evacuee



Results

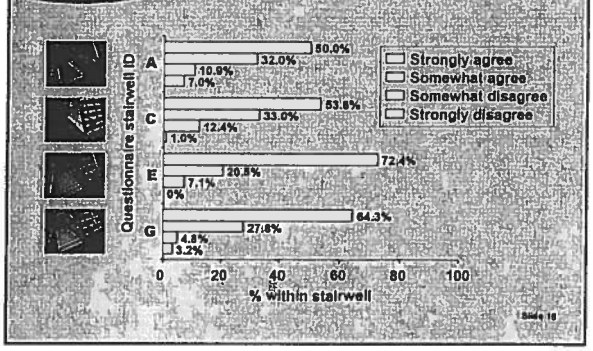
Confidence level of 5 , potential variation of 3 points on questionnaire results

Stairwell used	Returned questionnaire	Evacuees observed	Return percent
A	130	345	38%
E	132	287	46%
G	128	281	46%
C	99	278	36%
Total	489	1,191	41%

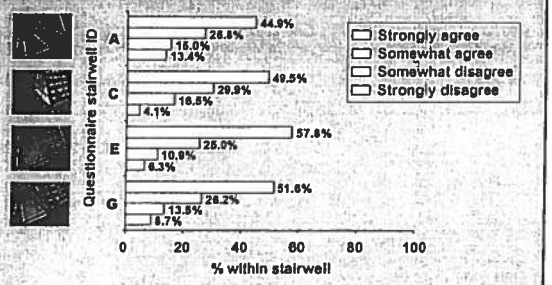
Judgment of Visibility

Judgment	Percentage of response, Stairwell			
	A	E	G	C
Excellent and good	50%	67%	62%	56%
Not very good and poor	50%	33%	38%	44%
Total	100%	100%	100%	100%

Each Step Was Easy to Identify



The Last Step of Each Flight Was Easy to Find



Overall Stairwell Rating on Each Attribute

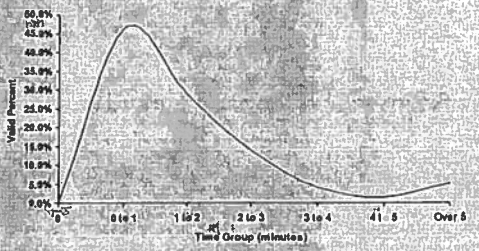


Attribute	Rating			
	1st	2nd	3rd	4th
Handrail was easy to find	E	G		A
rs step of each flight was eas to locate	E	G	A	C
Each st was easy to identify	E	G	C	A
Last step of each flight was easy to find	E	G	C	A
Directional signs were visible	E	G	A	C
Obstructions were well marked	E	G	A	C
Re-entry floors were well identified	G	E	A	C
Final exit was well marked	G	A	E	C

Judgment of Crowd Density

Judgment	Percentage of response, Stairwell			
	A	E	G	C
Very crowded and slow	24%	50%	29%	31%
Crowded but moving well	67%	46%	62%	54%
Few others around	8%	4%	9%	14%
I was alone	1%	0%	0	1%

Time to Start



Initial Response

- 99% heard the fire alarm
- 81% were at their desk
- They took the time to do one or several actions

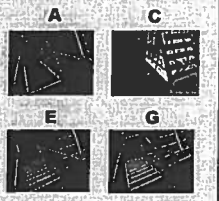
Action	Frequency	Percent
Get dressed	335	68.5
Gather valuables	265	54.2
Secure file or information	222	45.4
Follow warden's instructions	208	42.5
Return to office	75	15.3
Discuss with a colleague	56	11.5
Seek more information	23	4.7
Continue working	14	2.9

Speed and Density

Stairwell	Mean density, p/m²	Observed mean speed, m/s	Calculated speed, m/s
A	1.56	0.66	0.63
E	1.60	0.40	0.62
G	1.58	0.57	0.62
C	1.60	0.66	0.62

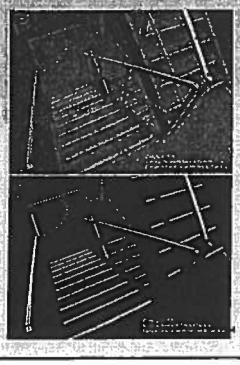
Conclusions

- With regard to movement speed, the stairwells performed similarly: they were crowded and slow.
- Stairwell E was particularly slow, mainly because of two evacuees with limitations.
- Ratings for stairwells A (L markers) and C (emergency lighting) were similar on several questions.
  - They received less positive judgements than E and G.



Conclusions (cont'd)

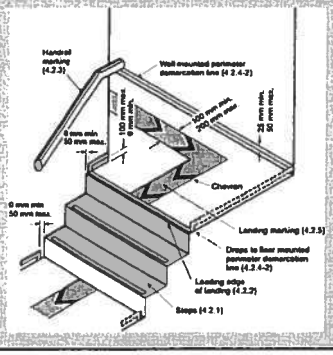
- Stairwell E was judged the best overall.
- People want marking across each step.
- Handrail was used by more than 80% of the evacuees, which makes marking of the handrail a must.



Installation Guide for PWGSC buildings

On each floor
- Marking of the floor exit door

In the Stairwell
- Steps
- Handrail
- Perimeter line
- Landing marking
- Signs



Questions?

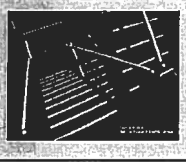
A



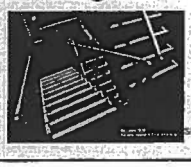
C



E



G

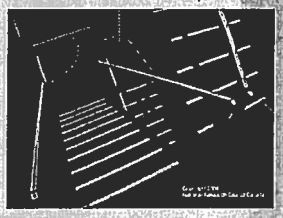


Future Studies

1. Longitudinal studies
2. Material performance
3. Visibility in smoke
4. Drill with installation according to Guide

Longitudinal Studies

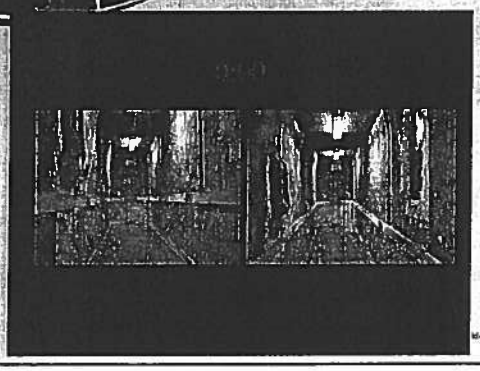
- At the C.D. Howe building measure output every 6 months
- Install material in additional locations to measure over time



Material Performance

- Study the material performance in a control environment for different conditions
  - heat,
  - cold,
  - different charging lights,
  - accelerate aging
  - anything else?

Visibility in Smoke



Visibil t in smoke

- Installation of the material in our 10-storey tower in Almonte. Evaluation of the visibility in smoke with camera in a corridor and the stairwell.
- Set fire scenario: office fire with sprinklers
- Lights on / lights off

Drill with Installation

- Conduct a drill in a building with installation according to Guide proposal
- Test installation with groups of subjects
- Test alternative proposals

Moving Forward

- Develop objectives and plan for research needed
- Build experimental set-up or select building to study
- Secure funding
- Identify partners

More information

- The NRC publication website:

www.nrc.ca/irc/ircpubs