

Alternative Solutions

- No guidance or training available
- Designers not sure what to provide
- AHJ evaluations



Prescriptive Solution or Performance Level → Objective same

6" Batt Insulation or insulation \geq R20 → Energy Conservation

wall construction or FRR \geq 1 hr → compartmentalization fire protection

limiting distance or heat flux \leq 50 kW/m² → preventing fire spread



Why would we be moving to Performance Based Codes?

- to save construction costs
- allows more flexibility in the design
- prescriptive solutions may not be appropriate
- we can analyze the performance levels better



Future Codes → Prescriptive Solutions

- provide direct physical solutions
- no analysis / evaluation required
- easier to apply / regulate



Alternative Solution Models

1. Comparative Performance Level Method
2. Reduced Building Code Requirements Method
3. Evaluation of the Performance Level



1. Comparative Performance Method

Performance Level of Alternative Solution ≥ Performance Level of Accepted Solution

What is an Alternative Solution?

NBC Div A 1.2.1.1(1)

"Compliance with this Code shall be achieved by

(a) complying with the applicable solutions in Division B, or
(accepted solution)

(b) using alternative solutions that will achieve at least the minimum level of performance required by Division B in the areas defined by the objectives and functional statements attributed to the applicable solutions."




Example
 5/8" type X GWB → 40 min FRR
 (accepted solution or the "Building Code" solution)


New Mineral Wool Cladding → 50 min FRR
 (proposed Alternative Solution)
 (tested by approved agency to similar standard & documents)

PL of Alternative Solution ≥ PL of Prescriptive Solution
 50 min FRR ≥ 40 min FRR

Assuming no other requirements necessary (i.e. lateral stability)



Page 7




2. Reduced Building Code Requirements

Lower Actual Demand → Proportionately Reduced Building Code requirements


Example

- Occupant load = 500 (as per table 3.1.17.1)
- Number of Water closets required = 20 (accepted solution)
- Actual Occupant Load = 50
- Number of Water Closets actually provided = 2

Actual Performance Level is the same (1 W/C for every 25 Occupants)



Page 8




3. Evaluation of the Performance Level


- Prove that the lower Performance Level is acceptable

Example: Longer Travel Distances to Exits

- very low occupant load (less than less than table 3.1.17.1)
- all occupants are familiar with the building and the egress routes (full time employees)
- building is only occupied during daytime hours by the occupants (8am to 6pm)
- occupants are not sleeping or resting in the building
- all occupants in the building are able bodied & able to self-evacuate (healthy adults between 20 & 50 years)
- the egress routes have good emergency lighting



Page 9



1. Comparative Performance Level Method

- 1. Establish the Code Sentence(s) (which is being substituted)

Evaluation of Accepted Solution

- 2. Find ALL the OS & FS
- 3. Assess each OS & FS
- 4. Determine PL of each OS & FS

Evaluation of Alternative Solution

- 5. Establish a Test Methods (for each OS & FS)
- 6. Determine PL for each OS & FS

- 7. Compare the PL



OS & FS determine what is to be measured
NOT the measurement themselves

Comparison of PL on ALL

- Objective Statements (OS)
- Functional Statements (FS)

is required

Intent Statement (from NRC website)

<http://codes-guides.nrc.ca/IA/10NBC/intentframe.html>



Example

3.3.1.23. Obstructions

1) No obstruction shall be permitted in any *occupancy that would restrict the width of a normal means of egress from any part of a floor area to less than 750 mm unless an alternative means of egress is provided adjacent to, accessible from, and plainly visible from the obstructed means of egress.*

How does Sentence 3.3.1.23(1) work? (accepted solution)


by having all points along the means of egress $\geq 750\text{mm}$
(or a 2nd means of egress)




Examples of Non-Compliance (without a 2nd means of egress)

- doorway clear widths = 600mm (< 750mm)
- aisles between shelving units = 500mm (22") (prevent persons from passing)
- extinguisher in a 750mm corridor making the clear width = 650mm (obstruction that slows down persons)

750mm = 30" 600mm = 24"




Page 13




NBC Div A Table 3.9.1.1 → {3.3.1.23(1)} → [F10-OS3.7]

3.3.1.22. Common Laundry Rooms	
(1)	[F03-OS1.2] ←
	[F03-OP1.2] ←
(3)	[F02-OS1.2] ←
	[F02-OP1.2] ←
3.3.1.23. Obstructions	
(1)	[F10-OS3.7] ←
3.3.1.24. Signs in Service Spaces	
(1)	[F10-OS3.7]
3.3.1.25. Welding and Cutting	
(1)	[F03,F02-OS1.2]
	[F03,F02-OP1.2]

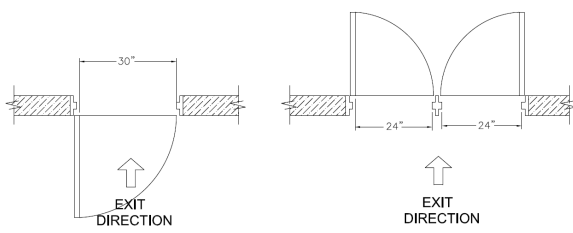


Page 14




Proposed Alternative Solution


25ft x 25ft room with 1 egress door and occupant load = 25
Is this proposed solution going to improve or slow down the evacuation?



ACCEPTED SOLUTION PROPOSED ALTERNATIVE SOLUTION



Page 15



OS3.7 → NBC Div A 2.2.1.1(1) (lists Objective Statements)

OS3.7 An objective of this Code is to limit the probability that, as a result of the design or construction of the building, a person in or adjacent to the building will be exposed to an unacceptable risk of injury due to hazards, The risk of injury due to hazards addressed in this Code are those caused by **persons being delayed in or impeded from moving to a safe place during an emergency**

- “OS” = occupant safety
- “OP” = fire & Structural protection of Buildings
- “OH” = occupant health
- “OA” = occupant accessibility



Objective Statement Evaluation

. . . . persons being delayed in or impeded from moving to a safe place during an emergency

What is the objective?

Persons are not delayed in an emergency

PL of Accepted Solution

10 persons delayed for every 100 persons passing (when doorway is 750mm wide)

(needs to be proven - by some rational means)



F10 → NBC Div A 3.2.1.1(1) (lists functional statements)

F10 To facilitate the timely movement of persons to a safe place in an emergency.

Functional Statement Evaluation

What is the purpose? How does this work?

To provide a timely movement of persons in an evacuation

PL of Accepted Solution

T = 120 second (from FAS activation until all person have passed through a room doorway)

(needs to be proven - by some rational means)



Alternative Solution Analysis

Provide a rational test method to determine the PL

Perform the PL measurement for each OS & FS

OS PL = 16 persons /100 person for single 24" door

OS PL = 8 persons (are delayed during evacuation with two 24" doors)

FS PL = 100 second (to evacuate room)

(both need to proven by some rational means)



Comparison of Performance Levels

Alternative Solution

Accepted Solution

8 persons = OS PL \geq OS PL = 10 persons

(fewer people are delayed)

100 seconds = FS PL \geq FS PL = 120 seconds

(faster evacuation time)

Alternate Solution is an acceptable solution based on the PL is "as good as" the Accepted Solution



Responsibilities & Roles

Designer

- to take responsibility for the Alternative Design
- to prove Alternative Solution PL \geq Accepted Solution PL

AHJ

- to confirm the Submission is accurate
- to critically review the Alternative Solution
- to be fair, consistent & transparent



Precedents of Alternative Solutions

- An approved Alternative Solution is binding for that particular building only (assuming no later circumstances have changed that would affect the performance level of the Alternative Solution)
- Accepted Alternative Solution used as an example to build a case for future Alternative Solution submissions
- Every Alternative Solution has its own unique circumstances and should not be considered a precedent for any future project.



**Importance of Documenting the Alternative Solution (AS)
(don't want the AS to be lost or forgotten over time)**

1. Provide documented rationale for allowing/rejecting the AS
2. Subsequent building renovations, additions or modifications don't affect the AS
3. On-going maintenance of AS
4. Monitor the AS performance
5. Later research might find AS inadequate
6. Awareness for AHJ & Designers on other projects



Ways of Recording the Alternative Solution

- Boldly highlighted on front page of submitted drawings
- Clearly labelled on Building & Occupancy Permits
- Clearly noted within the AHJ's project files
- Separate AHJ library of AS Proposals (both accepted & rejected)
- Building Placard



Format for Alternative Solution Submissions

1. Design Professional
2. General Outline
3. Evaluation of Accepted Solution PL
4. Evaluation of Alternative Solution PL
5. Comparison of Performance Levels
6. Other Supporting Evidence



1. Design Professional

- Qualifications
- Responsibility

2. General Outline

- Description of Alternative Solution
- Accepted Solution being substituted



3. Evaluation of Accepted Solution PL


- (a) OS & FS Evaluation (each one)
- (b) Method to determine PL
- (c) Performance Levels
 - OS PL = ???
 - FS PL = ???




4. Evaluation of Alternative Solution PL
 (a) Method to determine PL
 (b) Performance Levels
 • OS PL = ??
 • FS PL = ??
 (c) Unintended Consequences

5. Comparison of Performance Levels

6. Other Supporting Evidence




Page 28




Steps in Alternative Solutions Review

1. Organized & complete package from designer
2. AHJ Review
3. AHJ response to Designer
4. Resubmission of AS by Designer




Page 29




AHJ Review of Alternative Solutions

1. Is submitted information organized and complete?
2. Is the design professional qualified?
3. Is the Design Professional taking full responsibility for the proposed Alternative Solution?
4. Are the submitted documents signed & sealed by the Design Professional?
5. Do you agree with the items to be measured (from the OS & FS)?
6. Do you agree with the measurement methods?
7. Is the submitted information accurate?
8. Does the Alternative Solution perform at least as well as at the Accepted Solution?
9. Are there other consideration/ consequences (unintended consequences) for allowing the Alternative Solution?



Page 30



NBC 2010

3.8.3.3. Barrier-Free Path of Travel

- 1) ~~Every doorway that is located in a barrier-free path of travel shall have a clear width of not less than 800mm when the door is in the open position.~~

MBC 2011

3.8.3.3. Barrier-Free Path of Travel

- 1) Every public pedestrian doorway shall have a clear width of not less than 825mm when the door is in the 90° open position, measured from the face of the door hinges to the face of the door stop at the door jamb.

Alternative Solution for 2 – 24" doors not acceptable



IS A PEER REVIEW REQUIRED?

Are the consequences for allowing the Alternative Solution:

- 1. For this building?
- 2. For other present buildings or future projects?
- 3. For other jurisdictions?
- 4. For other Codes?



Other Considerations

- 1. Confirmation at the end of the project by the Design Professional that circumstances have not changes that would affect the Alternative Solution performance?
- 2. A separate submission for each Alternate Solution?
- 3. Additional permits fees for additional review / evaluation?
- 4. Bulletins issued on acceptance of Alternative Solutions?



Future Goals

To build a library of both approved & rejected Alternative Solutions

- comparison of accepted / rejected submissions
- education for AHJ's & designers (submission format, rational)
- better future submissions & evaluations
- may eventually lead to NRC using Alternative Solution as an approved Accepted Solution

Will require sharing

- not intended to critique designer / AHJ
- removing specific project information essential



Calvin Gray
Office of the Fire Commissioner
508 – 401 York Ave
Winnipeg MB R3C 0P8
phone: 204-945-3322
email: calvin.gray@gov.mb.ca