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STRUCTURED PARKING
SNOW AND ICE MANAGEMENT SEMINAR

Seminar Goals:
• Overview of structural and waterproofing systems/limitations
• Maintenance of structured parking
• Pitfalls and opportunities
Snow and Ice Management Seminar

Seminar Outline

Part I: Garages 101

A. Systems Overview
   1. Structural
   2. Waterproofing
B. Structure Loads
C. Common/Uncommon Damage

Part II: Garage Maintenance

A. Routine Maintenance
B. Preventative Maintenance
C. Periodic Repair/Replacement
D. Winter Related

Part III: Responsibilities/Opportunities Discussion

A. Owner/Management/Contractor Responsibility
B. Contracts
C. Open Discussion
PreCast Pre-Stressed Concrete

Double Tee Section
Typical Floor System in PreCast Garages
CAST-IN-PLACE POST-TENSIONED CONCRETE

Post-Tensioned Tendon Section
Hybrid Steel/Precast Concrete
Other Structural Systems

- Post tensioned slab/structural steel hybrid
- Concrete filigree slab/beam
- Filigree/Structural steel hybrid
- Cast-in-place slab(s) on structural steel frame
- Post tensioned short span flat slab
- Cast-in-place short span (multiple variations)
Expansion Joint Seals

1/4" CHAMFER

ELASTOMERIC CONCRETE HEADER

MEMBRANE FLAP
Joint Sealants

Waterproofing Systems
Traffic Bearing Membrane

VERTICAL SURFACE (WALL OR COLUMNS)

STRAIGHT FINISHED LINE

TRAFFIC TOPPING (FLOOR SURFACE OR CURB)

HORIZ / VERT TRANSITION

COVE SEALANT.

ISOMETRIC

TRAFFIC TOPPING
Snow and Ice Management Seminar
Part I: Garages 101
Structure Loads

Dead Loads

**Structural Elements**
- Beams
- Columns
- Floorplates
- Spandrels

**Architectural Elements**
- Stairs
- Doors
- Windows
- Facade Elements

**Utilities**
- Pipes
- Conduits
- Mechanical Elements
Live Loads
# Snow and Ice Management Seminar
## Part I: Garages 101
### Structure Loads

#### Live Loads

| Table 1607.1: Minimum Uniformly Distributed Live Loads, Ld, and Minimum Concentrated Live Load, Lc |
|---|---|---|
| **OCCUPANCY OR USE** | **UNIFORM** (psf) | **CONCENTRATED** (ps) |
| 1. Apartments (non-residential) | | |
| 2. Access floors | 50 | 2,000 |
| 3. Offices and shops | 35 | — |
| 4. Assembly areas | 60 | — |
| 5. Balconies and decks | Same as occupancy served | — |
| 6. Canopies | 40 | — |
| 7. Concessions | 60 | — |
| 8. Garages | 100 | — |
| 9. Domes, roofs, and exteriors | 100 | — |
| 10. Elevator machine room and interior area (not over 2 square yards) | 300 | — |
| 11. Equipment | 100 | — |

#### Fire escapes
- On single-family dwellings only
  - 13. Fire escapes: 100
  - 14. Garages (passenger vehicles only): 40^

#### Handrails, guards and grab bars

#### Helipads

#### Hospitals

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Note a: See Section 1607.7

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2015 International Building Code

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Sima
Snow & Ice Management Association

Walker Parking Consultants
Walker Restoration Consultants
Design Vehicle vs Common Maintenance Vehicles

Design Vehicle
7,500 lbs

DO NOT ASSUME MAINTENANCE EQUIPMENT CAN BE USED ON A PARKING STRUCTURE. PURSUE QUALIFIED GUIDENCE

VS.

Skid Steer Loaders
6,600 lbs

Back Hoe Loaders
16,000 lbs

Truck with Plow and Sander (full) 13,300 lbs
Front End Loaders
42,000 lbs
Snow Loads

In USA Ranges from 0 psf to 100 psf

2015 International Building Code
Figure 1608.2
Concentrated Loads

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>13. Fire escapes</td>
<td>100</td>
</tr>
<tr>
<td>On single-family dwellings only</td>
<td>40</td>
</tr>
<tr>
<td>14. Garages (passenger vehicles only)</td>
<td>40 m</td>
</tr>
<tr>
<td>Trucks and buses</td>
<td>Note a</td>
</tr>
<tr>
<td>15. Handrails, guards and grab bars</td>
<td>See Section 1607.7</td>
</tr>
<tr>
<td>16. Helipads</td>
<td>See Section 1607.6</td>
</tr>
<tr>
<td>17. Hospitals</td>
<td>80</td>
</tr>
<tr>
<td>Corridors above first floor</td>
<td>1,000</td>
</tr>
</tbody>
</table>

*Note:*
- Floors in garages or portions of buildings used for the storage of motor vehicles shall be designed for the uniformly distributed live loads of this Table or the following concentrated loads: (1) for garages restricted to passenger vehicles accommodating not more than nine passengers, 3,000 pounds acting on an area of 4½ inches by 4½ inches; (2) for mechanical parking structures without slab or deck that are used for storing passenger vehicles only, 2,250 pounds per wheel.
Barrier Impact

Displaced Capstone

Barrier cable system breach

1607.8.3 Vehicle barriers. Vehicle barriers for passenger vehicles shall be designed to resist a concentrated load of 6,000 pounds (26.70 kN) in accordance with Section 4.5.3 of ASCE 7. Garages accommodating trucks and buses shall be designed in accordance with an approved method that contains provisions for traffic railings.

1607.9 Impact loads. The live loads specified in Sections 1607.3 through 1607.8 shall be assumed to include adequate allowance for ordinary impact conditions. Provisions shall be made in the structural design for uses and loads that involve unusual vibration and impact forces.
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Part I: Garages 101
Common Damage

Environmental Damage

Rust, Delamination, and Spalling

Scaling
Environmental Damage (Signs)

Cracks

Rust Stains
Service Related Damage

- Wear to Expansion Joint
- Wear to Traffic Topping
- Fading Marking Paint
Service Related Damage

Commercial truck wheel punched through tee flange.
Uncommon Damage

Service Related Damage

Tanker truck breaks through deck while pumping water out of lower level of garage

PHOTO REDACTED
Service/Maintenance Damage (Snow)

DO NOT ASSUME SNOW CAN BE PILED ON TOP OF A PARKING STRUCTURE. PURSUE QUALIFIED GUIDENCE.

Snow piled up in corner of garage causes deck to collapse
Service/Maintenance Damage (Snow)

DO NOT ASSUME SNOW CAN BE PILED ON TOP OF A PARKING STRUCTURE.
PURSUE QUALIFIED GUIDENCE
Impact damage from plows and other maintenance machinery
Snow and Ice Management Seminar
Part I: Garages 101
Common Damage

Maintenance Related Damage

Plow damage to **worn** Expansion Joints
Break – 15 Minutes
Maintenance Manuals

Precast/Pre-stressed Concrete Institute 2004

National Parking Association 2015

Walker Parking Consultants 2014
Part II: Garage Maintenance

Outline

- Routine Maintenance
- Preventative Maintenance
- Periodic Repairs/Replacement
- Winter Related Maintenance
Routine Maintenance

- General Cleaning: Trash removal, drain cleaning, sweeping, window cleaning
- Expansion Joints/Control Joints: Clean out debris
- Striping and Graphics: Re-paint when necessary
- Electric / Mechanical Equipment: Change filters, change lamps, etc.
Preventative Maintenance

- **Structural Systems:** Inspect for Spalling, Delamination, Scaling, and other signs of damage. Inspect steel elements for rust, and weld damage. Also look for potential safety hazards such as loose concrete or tripping hazards.

- **Equipment:** Review systems like elevators, lighting, plumbing, fire protection, and security and perform regular maintenance. Check snow removal equipment to make sure it is operating properly before use.

- **Protective Systems:** Inspect systems like joint sealants and expansion joint seals are working properly and are free from debris and cracks/tears.

- **Architectural Systems:** Inspect condition of doors, signage, envelope systems, etc.

- **Repair or address identified deficiencies.**
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Part II: Garage Maintenance

Periodic Repairs/Replacement

- Concrete Repairs: Repair spalls, delamination's, cracks and scaling.
- Waterproofing: Replace worn and damaged waterproofing elements.
- Connection Distress: Repair broken / cracked connections between concrete / steel members.
- General: Repair / replace inoperable doors, heat trace, etc.

Seek a specialist to evaluate the structure before attempting any repairs. Structural repairs should be designed by a qualified professional.
Winter Related

Fall (Pre-Winter)
- Clean the deck/stairtowers
- Check drain operation
- Repair waterproofing/stairtower envelope leaks
- Drain down domestic water
- Check drain drums/stand pipe

Winter
- De-ice
- Snow management
- Mitigate damage related to life safety

Spring (Post-Winter)
- Clean the deck/drains/stairtowers
- Repair winter damage (i.e. waterproofing)
Break – 15 Minutes
Owner / Management Responsibilities:

• Maintain the facility in a safe and operable condition
• Maintain parking supply
• Maintain revenue stream
• Control costs
• Know the condition and limits of the facility

Snow/Ice Management Contractor Responsibilities

• Understand condition and limits of the facility
• Define contract scope
• Do what is in the contract
Contract Scope (potential)

- Pre-Winter Inspection
- Pre-Winter Maintenance/Repairs
- Ice Management
- Snow Management
- Post Winter Inspection
- Post Winter Maintenance/Repairs
- Limit Liability
Opportunities

- Pre-Winter
  - Clean deck/drains
  - Maintenance repairs
  - Warrantee enforcement

- Post-Winter
  - Clean deck drains
  - Fix winter damage (misc. impact, waterproofing, landscaping, doors)
  - Warrantee enforcement

- Limit Liability
Questions/Discussion

Link to Survey:

https://www.surveymonkey.com/r/WorkshopParking

References:

Precast Concrete Institute: https://www pci.org/

National Parking Association: http://weareparking.org/

Post Tensioning Institute: http://www.post-tensioning.org/


International Parking Institute: http://www.parking.org/