Dunnage, Loading & Shipping
Presented by: Mitch Rector, National Precast Concrete Association
Learning Objectives
• By the end of this course you will be able to:
  – Define dunnage and identify the main functions, types, properties, and applications of dunnage
  – Identify appropriate dunnage materials selection
  – Identify proper positioning of dunnage materials
  – Be able to identify proper stacking and storing techniques
  – Be able to identify proper loading and shipping techniques

Outline
• Introduction
• Dunnage
  – Main Functions
  – Types & Properties
  – Use and Application
  – Appropriate Materials Selection
• Proper Positioning of Dunnage Materials
  – Proper and Improper Methods
• Stacking Methods/Configurations
  – Proper and Improper Methods
• Loading & Shipping Procedures
  – Proper and Improper Methods

Introduction
• Dunnage
• Stacking
• Loading & Shipping

Dunnage
Inexpensive or waste material used to protect and load securing cargo during transportation

Material used to support loads and prop materials off the ground

Dunnage
NPCA Quality Control Manual
Section 4.8.3 Storage of Products
Products shall be stored in a manner that will minimize damage caused by uneven bearing, improperly located dunnage blocks, stacking products too high or difficulty in handling

Dunnage- Types
• Wood
• Styrofoam
• Plastic
• Rubber
• Plywood
• Fabric
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Dunnage - Properties

<table>
<thead>
<tr>
<th>Qualities</th>
<th>Wood</th>
<th>Plastic</th>
<th>Styrofoam</th>
<th>Rubber</th>
<th>Fabric</th>
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<tbody>
<tr>
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<td>Low</td>
<td>Average</td>
<td>Low</td>
</tr>
<tr>
<td>Durability</td>
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<td>High</td>
<td>Low</td>
<td>High</td>
<td>Average</td>
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<tr>
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<td>Low</td>
<td>High</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>Average</td>
<td>Average</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
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</tbody>
</table>

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Dunnage - Use & Application

• Prevents damage during storage and shipping
• Provides easy access for lifting using equipment
• Dissipating and localizing sweat and moisture

Dunnage vs. No Dunnage
Proper Procedures without Dunnage

• Products should preferably be stored on level surfaces
  – Gravel base, concrete pad, paved surface, compacted soils, etc.

• Bearing surfaces should be large enough to prevent chipping or fracturing of the product

City of Portland, OR.
Storage – All precast concrete products shall be stored in a manner that will maintain product quality, as well as provide damage protection from yard traffic
City of Portland, OR.

All concrete pipe greater than 60-inches in diameter shall be "stulled" with a minimum of two each, 4" x 4" wood posts providing vertical support during storage. This requirement shall apply both at the manufacturer’s storage yard and on the jobsite.

**Properly Placed Dunnage**

- Weight of the concrete product (dead load)
- Dead load causes tension and compression stresses
- Tension > Capacity of Concrete = Cracking

**Allowable bearing stress of \(0.3f'_c\)**

\[
\text{Maximum weight on bottom element would be: } \quad 0.3 \times f'_c \times \text{contact area}
\]
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Improperly Placed Dunnage

Incorrect:
Crack occurred when tension exceeded tensile strength of the concrete

At neutral axis (N.A.) stress is zero
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Stacking

NPCA Quality Control Manual
Section 4.8.3 Storage of Products

Products shall be stored in a manner that will minimize damage caused by uneven bearing, improperly located dunnage blocks, stacking products too high or difficulty in handling.

Commentary
Products should preferably be stored on level surfaces. Bearing surfaces should be large enough to prevent chipping or fracturing of the product.

Stacking

NPCA Quality Control Manual
Section 4.8.6 Plant Requirements

- Storage areas shall be maintained firm and level such that products are not damaged during handling and do not sink into the ground.
  - Products shall be stored to minimize damage.
  - The QC Inspector shall inspect the storage area and the stored product daily.

Stacking

- Appropriate stacking methods should be used to store precast elements to prevent any undue stresses and damages.
- Horizontal precast elements (slabs, planks, beams, hollowcore) can be stacked and supported separately or across the full width of the designated bearing points.
- Walls and façade panels are stored vertically, supporting their own weight using racks with stabilizers.
- Storage conditions play an important factor in achieving specified tolerances (bowing and warping).
- Slender panels should have additional lateral support.

Stacking

Stable construction of the stack depends on the following factors:

- Safe regulation of height to dimension of base
- Sound interlocking of products
- Compact construction and avoidance of transfer stress in any dunnage used for artificial bonding
- Shape of products
- Determination of the aggregate weight to be borne by the components in the lowest tier of the stack
- Consistent placement
Properly Stored Product

Horizontally Stacked Components

- General rule of thumb: stack height should not be higher than twice the component width (unless specifically designed and documented otherwise)
- Provisions should be made to minimize the likelihood of accidental impact from vehicles and other components

Stacking- Pallets

- Be of sound construction
- Adequate strength for loads which they are used
- Lower pallets should be of suitable strength and in good condition
- Unit loads must be able to support the weight above
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Hazards Associated with Storage of Precast Products

- Haphazard storage
- Lack of storage or safe storage procedure
- Unstable precast products due to inadequate supports
- Overloading due to inadequate design of supporting structures for supporting racks/frames
- Insufficient ground support strength
- Exceeding stack stability height
- Lack of in-house enforcement on rules regarding safe storage procedures
- Storage area should be large enough for precast components to be stored properly with adequate room for lifting equipment and for maneuvering trucks, cranes, and other vehicles

Destacking

Basic Rules of Thumb for Breaking Down Stacks

- One person should be responsible for the manner which the stack is reduced
- If the person in charge of destacking had no part in erecting the stack, he or she should obtain the erection information before work begins
- Stack should be taken down tier by tier

Shipping

The act or business of transporting goods

NPCA Quality Control Manual
Section 4.8.6 Plant Requirements

The QC Inspector shall spot check the final inspection of the products, loading and tie-down procedures

Shipping- Securement

Federal Motor Carrier Safety Regulations (FMCSR)

Cargo must be firmly immobilized or secured on or within a vehicle by structures of adequate strength, dunnage, or dunnage bags, shoring bars, tie-downs, or a combination of these
Federal Motor Carrier Safety Regulations (FMCSR)

- Tie-downs may be made of rope, chains or straps and must provide a downward force of 20% of the weight of the article the tie-down is securing
- Number of tie-downs is dependent upon size and weight of the cargo

Rule 393.110: Minimum number of Tie-Downs

- Size and Weight
  - <5ft & <1,100 lbs - 1 tie-down
  - <5ft & >1,100 lbs - 2 tie-downs
  - Any item between 5-10 ft - 2 tie-downs
  - Each additional 10 ft in cargo length - additional tie-down required
  - I.E.- 12 ft load requires 3 tie-downs
  - I.E.- 22 ft load required 4 tie-downs

Planned according to general erection sequence to minimize unnecessary site storage and handling

- Transport in a manner with minimal change in orientation and sequence
  - Example: wall panels using A-Frame type trailer
- Should be loaded and delivered with proper:
  - Supports
  - Frames
  - Cushioning
  - Tie-Downs
- Adequate packing or protection to the edges of architectural elements to minimize risk of damages during transit

Slabs in the yard may experience different loading than slabs during transit due to vertical forces created as the truck travels down the roadway at 50 mph

- May not cause structural problems, but jobsite inspector may reject the load if cracking is evident

Proper support on the truck bed can help minimize cracking during shipping.
Preserving
- Load pipe as compactly as possible
- Immobilize symmetrically stacked pipes by securing them in groups
- Use blocking systems and tiedowns to increase the effect of friction
- WLL must be more than ½ the total working weight of all pipes in the group
- Run tiedown through a pipe in an upper tier or over lengthwise tiedowns

Blocking must prevent rolling or rotating
- Blocking may be one or more pieces placed at equal distances from the center of a pipe

On Spacers
- Load bell pipe on at least two longitudinal spacers

One Tier
- Bells alternate on opposite sides of the vehicle
- Stagger the ends of consecutive pipe
- If ends can’t be staggered, they must be aligned

Conclusion
- Dunnage
- Stacking
- Shipping

Questions?
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