

**127<sup>th</sup> ANNUAL Damage Prevention & Freight Claims Conference**  
Where East Meets West: Partners in Evolution  
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ASSOCIATION OF AMERICAN RAILROADS TAPPI

# Load Planning – From the Basics Boxcars

# Reasons to Design a Load Plan

- ❖ Protection from Load Shift
  - *Safety*
  - *Cargo Protection*
- ❖ Economics - Maximize Payload

# What causes Load Shift

- ❖ The primary cause of load shift is improper unitization and load securement combined with the inertial forces of transit.



# Forces of Transportation- Boxcar

- ❖ Rail Yard Humping and Switching.
- ❖ Longitudinal Impacts and Slack Action
- ❖ Elevated Track.
- ❖ Rail Sway.
- ❖ Harmonic Vibration.



# How to Design The Best Option

- ❖ Gather the Facts
- ❖ Understand the Product
- ❖ Basic Principles of Load Securement
- ❖ Design The Load
- ❖ Sample Load Plans
- ❖ Test Loads

# Gather the Facts

- ❖ Target Car?
- ❖ Transit?
- ❖ What type of product?
- ❖ What are the unit measurements?
- ❖ What platform is the product shipped on?
- ❖ Is there over hang, under hang or flush?
- ❖ What type of packaging?
- ❖ What is the product weight?

# Gather the Facts

## Target Car Type and Dimensions

### ❖ Insulated/Refrigerated Cars

- Typical Lengths: 64; 68; 72
- Typical Widths: 9; 9-1
- Typical Heights: 11 - 12
- Typical Weights: 180,000 – 195,000

### ❖ Dry Cars

- Typical Lengths: 50; 60
- Typical Widths: 9-4; 9-6
- Typical Heights: 10-11; 13
- Typical Weights: 150,000 – 214,000
- Cushioned or Non-cushioned
- Door Type and Size

# Gather the Facts

## Transit

- ❖ Origin
- ❖ Destination
- ❖ Involved Railroads



# Understand the Product

## Dimensions and Packaging

### ❖ What Type of Product

- Dry – density
- Liquid – viscosity

### ❖ How is Product Unitized

- Stretch Wrap, Shrink Wrap, Netting or Strapping

### ❖ Package

- Cans/Pouch – cases, trays, bright stack
- Bottles – glass, plastic
- Bags – paper, plastic, size
- Drums – plastic, fiber, steel
- IBC – super sac, plastic, fiber, wood, metal

# Understand the Product

Value of the Product / Shipper Cost to Value

- ❖ Value of the product is tied to shipper's cost to value curve.
  - What is the product value?
  - Is the product easily replaceable?
  - Is it shipping direct to Customer or Forward Warehousing?

# Understand the Product

## Other Impact on Load Design

### ❖ Mixed Loads

- Same Product - same package – varying size
- Same Product – varying package – varying size
- Mixed Product – varying package – varying size

### ❖ Miscellaneous

- Lift equipment, inside/outside dock, door size, dock width, loading personnel and other organizational idiosyncrasies’
- Practical vs Theoretical

# Basic Principles of Load Securement

- ❖ The guidelines in this document are derived from the AAR Closed Car Loading Guide. For questions and more specifics regarding AAR minimum loading requirements: Please Refer to the AAR Closed Car Loading Guide at
  - <http://www.aar.com/standards/damage-prevention.html>
- ❖ Closed Car Loading Publications
- ❖ Circular 42-M General Rules Covering Loading of Carload Shipments of Commodities in Closed Cars and Part 6 Closed Car Loading Guide for Prepared Food and Similarly Packaged Goods

# Basic Principles of Load Securement

- ❖ Circular 42-M - Mandatory Rules and Requirements for the safe transit of goods.
  - Inspection and selection
  - Weight distribution
  - Center of Gravity
  - Car must be secured to prevent:
    - Car from tipping
    - Goods from moving into empty spaces
    - Ensure car can be unloaded from either door.

# Basic Principles of Load Securement

- ❖ Closed Car Loading Guide: Part 6 for Prepared Food and Similarly Packaged Goods
  - Minimum Loading Standards
    - Developed by Laboratory and Field Test
    - Approved by Damage Prevention and Freight Claims Committee
    - Intended for the safe transportation of goods in closed cars
    - Dependent on Product/Packaging – Additional securement maybe Necessary for Successful and Safe Transit

# Design the Load Plan

## Maximize Payload

- ❖ How Many Units Fit by Weight
  - Divide the Maximum Lading Weight Capacity of the Target Car by the Weight of the Unit.
    - This gives you the maximum number of units the car will hold.
    - EXAMPLE: Target car 60' TBOX

Approximate weight average 204,000

Assume Unit Weight 2150

Max Units by Weight = 94

# Design the Load Plan

## Maximize Payload

- ❖ How Many Units Physically Fit
  - Divide the Car Length by Product Length or Width
    - This gives you the maximum number of stacks the car will hold.
    - EXAMPLE: Target car 60' TBOX  
Car Length – 60'9"; Width – 114"; Height – 152"  
Example Unit Length – 48"; Width – 40"; Height 52"  
Max Units 2 High – 2 Wide = 18 Stacks or 72 pallets



# Design the Load Plan

## Minimize Voids

- ❖ Basic Math – Maximize Payload
  - Determine how much space is left over
    - 1) Car Length less Total Lading Length = Lengthwise Space
    - 2) Car Width Less Lading Width = Lateral Space
- EXAMPLE: Target car 60' TBOX
  - Lengthwise space -  $729'' - 720'' = 9''$
  - Lateral Space -  $114'' - 96'' = 18''$

This is a perfect world scenario.

# Design the Load Plan

## Basic Principles

- ❖ Weight Distribution – End to End and Side to Side
  - Do Not load more than 60% of the cargo in half the length of the Boxcar.
- ❖ Fill All Space Tight – End to End & Side to Side
  - Includes Any Pallet Under Hang
- ❖ Use Proper Securement Methods
  - Lengthwise Filler Minimum Compression 1500 psi/sqft
- ❖ Use Any Necessary Doorway Protection
  - Plug vs Sliding Door
- ❖ Block Height Changes
- ❖ Protect Product Orientation Changes

# Design the Load Plan

## Basic Principles

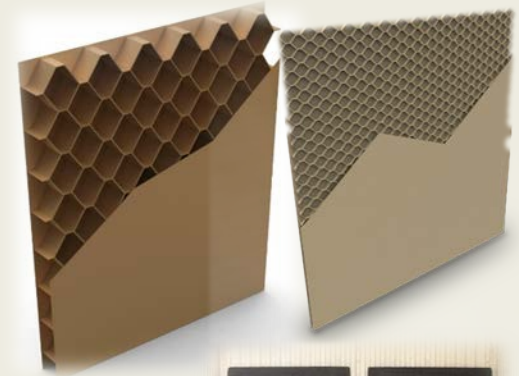
- ❖ User Proper Fitted and Level Air Bag
- ❖ Recommend Proper Pressure
  - *4-6 psi = Dry*
  - *6 psi = Refrigerated*
  - *8 psi = Frozen*
- ❖ Plan Air Bag to Fill between Minimum 4” to Maximum 12” After Inflation
- ❖ Buffer Air Bag
- ❖ No More than 2” Panels Directly Adjacent to Doorway Air Bags
- ❖ No More Than 1 Air Bag in the Same Lengthwise Row
- ❖ Do Not Use Air Bags Laterally in Doorway

# Design the Load Plan

## Types of Securement Materials

- ❖ Lumber
  - ❖ Strapping/Cargo Netting
  - ❖ Corrugated/Paper Void Fillers and Panels
  - ❖ Wood and Paper Panels
  - ❖ Air Bags
  - ❖ Flexible Bulkhead
  - ❖ Rubber Mats
  - ❖ Foam Bulkheads
  - ❖ Plastic Fillers and Panels.
- Typically, several securement materials are used together as a system to ensure complete and proper securement.

# Types of Securement Lengthwise



# Design the Load Plan

## Securement Lengthwise

- ❖ Maintain vertical alignment between stacks.
- ❖ Apply buffer sheets or panels when transitioning between slip sheet to pallets, or when pallet heights do not match or when changing unit orientation



# Design the Load Plan

## Securement Lengthwise

- ❖ If loading incomplete layers
  - Build up adjacent units with banded pallets
  - Use appropriate strength panels for step down
  - Use lateral air bags and/or strapping for step down



# Design the Load Plan

## Securement Lengthwise

- ❖ Lengthwise fillers/bulkheads or panels must be a minimum of 1500#'s per square foot
- ❖ No one lengthwise space can exceed 12"
- ❖ Lengthwise filler should meet height of the load
- ❖ Do not stack panels together in same void





# Design the Load Plan

## Securement Lengthwise

- ❖ Use appropriate level air bag for car weight and product
- ❖ Use air bags that meet the height/width of the lading
- ❖ Elevate air bag minimum of 1" above floor or pallet
- ❖ Buffer air bags with sheets or panels
- Panels adjacent to air bags should never be thicker than 2"



# Design the Load Plan

## Lengthwise Securement

- ❖ Air bag width is never to exceed 12" AFTER inflation
  - Ideal width is 4" – 8"
- ❖ Use appropriate PSI for application
  - Do not exceed recommended PSI printed on bag



# Types of Securement Lateral



# Design the Load Plan

## Lateral Securement

- ❖ Mandatory use of lateral filler material for all center and side voids with 18" of accumulated void or greater
- ❖ Recommended lateral filler material all center and side voids with accumulated width greater than 4"
- ❖ Drop fillers should cover approximately 3/4 height of stacks.
- ❖ Use lateral void filler in between stacks in doorways.

- ❖ Recommend use of lateral void filler between doors front



# Design the Load Plan

## Lateral Securement

- ❖ Lateral air bags are used to section load and mitigate pallet migration
- ❖ If loading units 3 wide, use buffer sheet between units to prevent wrap from sticking





# Types of Securement Miscellaneous



# Design the Load Plan

## Example 1 – Can Goods

### ❖ Gather the Facts

- Car Type - TBOX
- Product - #10 Cans Cases Slips and Pallets
- Full Cases
- 40 x 48 Pallet and 42 x 54 Slip
- Coast to Coast with at least 2 RR

# Design the Load Plan

## Example 1 – Can Goods

### ❖ Do the Math

- TBOX – 114W x 729L x 152H X  
204,000 Wt – 16’  
Double Plug doors
- #10 Cans Cases  
Slips and Pallets
  - 37.5W x 50L x 52H
  - 2350#
  - On pallets – 2”  
Under hang
  - On slips - Flush

- Units by Weight:  
 $204,000/2350=86$
- Units by Cube - Pts:  $729/40 = 18$  Stacks;  $56 \times 2 = 112$  so 2 High; 2 high x 2 wide x 18 stacks= 72 Units
- Under Hang on Pallets – 2”
- Units by Cube – slips:  $729/37.5 = 19$  stacks;  $52 \times 2 = 104$  so 2 High: 2 high x 2 wide x 19 stacks = 76 Units
- Unfilled Space Pallets:  $18 \times 40 = 720$ ;  $729 - 720 = 9$  Lengthwise;  $50 \times 2 = 100$ ;  $114 - 100 = 14$  Lateral
- Unfilled Space Slips:  $19 \times 37.5 = 712.5$ ;  $729 - 712.5 = 16.5$  Lengthwise;  $114 - 100 = 14$  Lateral



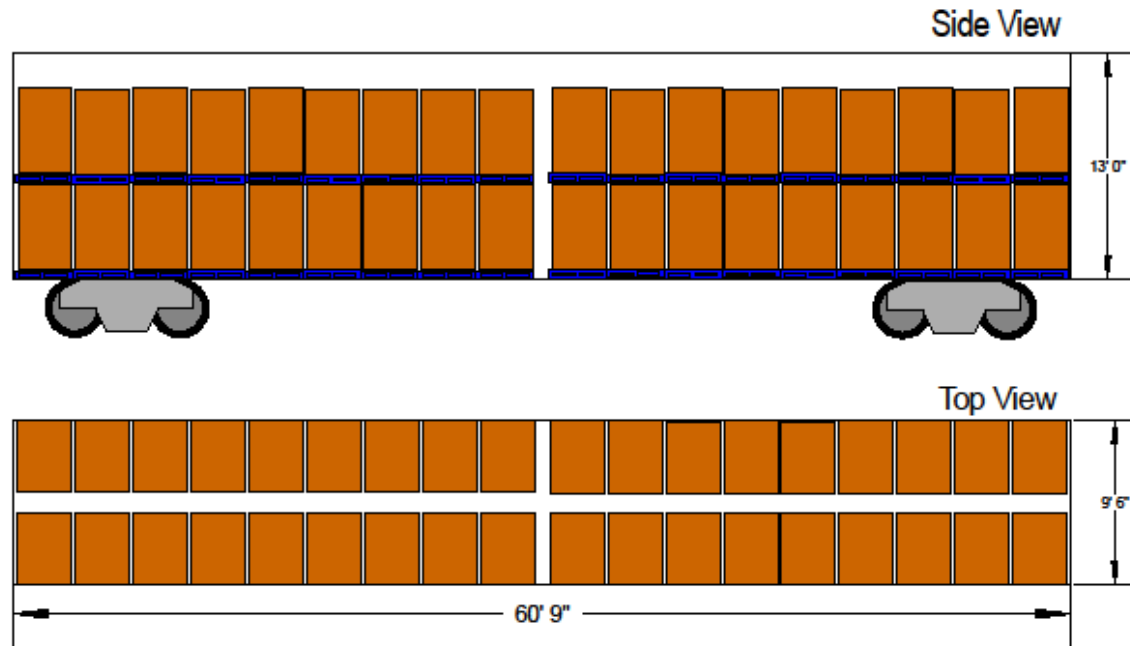
# Design the Load Plan

- Draw the Boxcar - #10 w/Pallets
  - TBOX has 16' centered Doors
- Address the Under Hang - 2" each pallet
- Fill in the Units
  - Start with the Car Ends - working to the Doorway
  - Know your left over space and how to fill it.
  - 9" Lengthwise / 14" Lateral
- Fill in Securement Materials

# Design the Load Plan



60' TBox  
#10 - 72 Pts



# Design the Load Plan

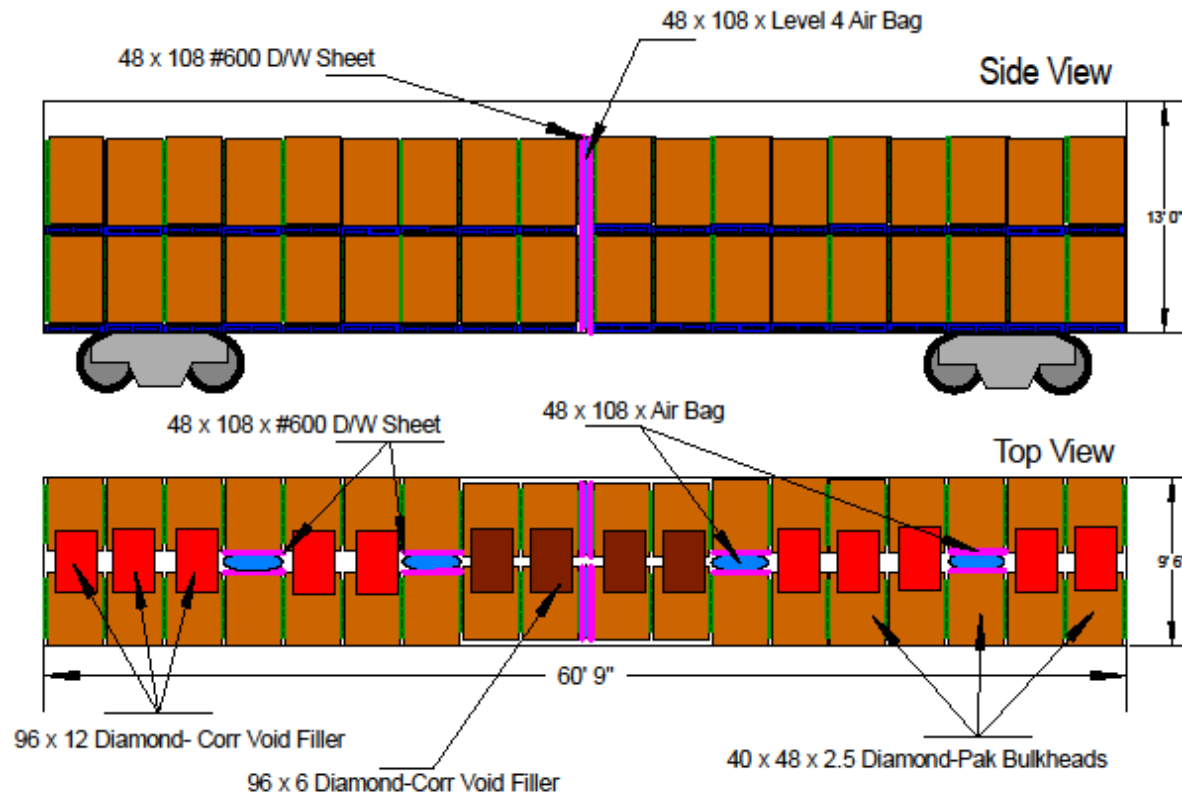
- Lengthwise – 9” – Air Bag to Tighten and Fill void
- Alignment Throughout to Car
- Buffer Air Bag from Pallets – Corrugated Sheet
- Fill Under hang 2.5” Panels
- Lateral – 14”
  - Units are not perfectly square
  - Allow a little room
  - 12” Center Void Fillers



# Design the Load Plan



60' TBox  
#10 - 72 Pts



# Design the Load Plan

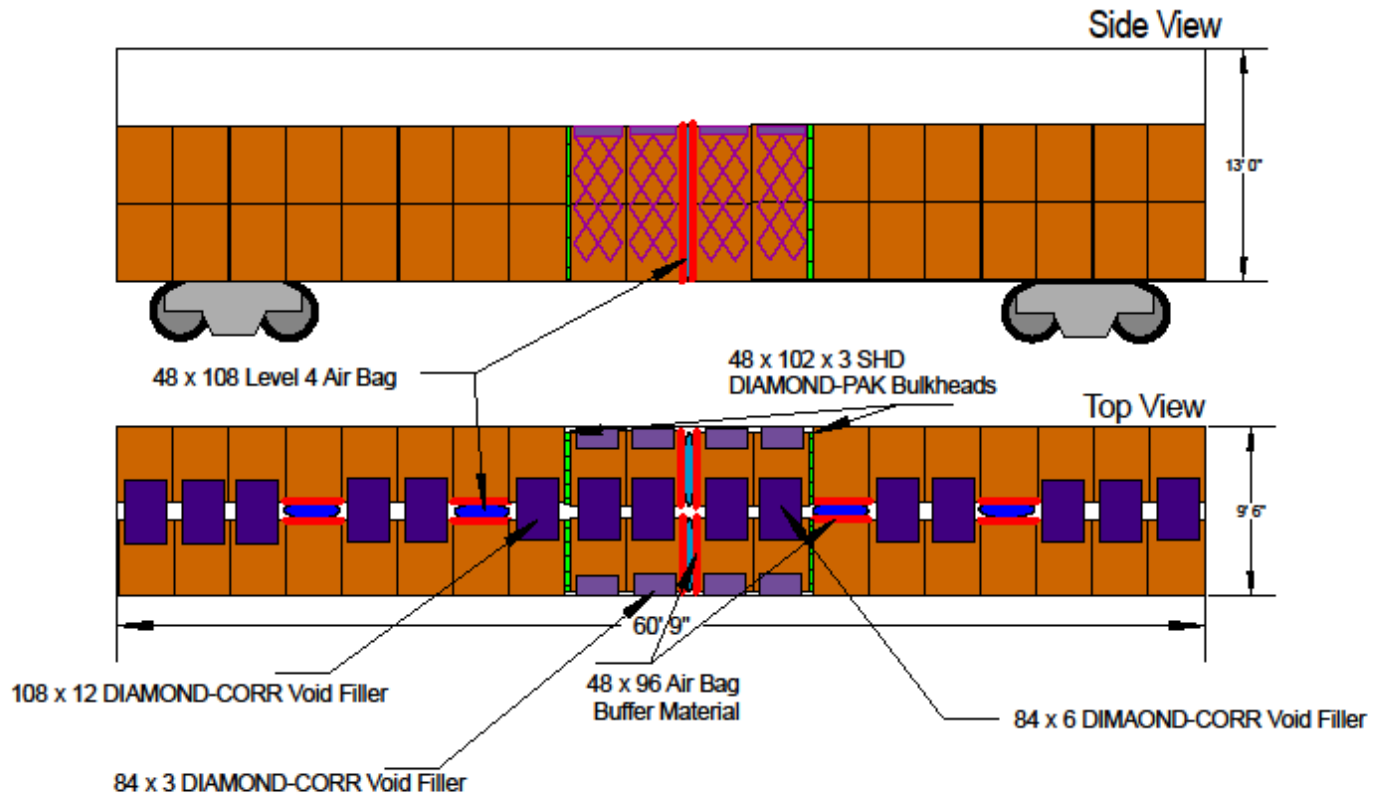
- Draw the Boxcar - #10 w/Slips
  - TBOX has 16' centered Doors
- Fill in the Units
  - Start with the Car Ends – working to the Doorway
  - Know your left over space and how to fill it.
  - 16.5” Lengthwise / 14” Lateral
- Fill in Securement Materials
- Doorway Challenge – Side Shift/Panels



# Design the Load Plan



60' - TBOX  
76 Units - Slips



# Design the Load Plan

## Example 2 – 50 kg Bags

### ❖ Do the Math

- RBOX – 114W x 606L x 121H X  
150,000 Wt – 12'  
Single sliding door
- 50 kg Bags  
Dehydrated Milk on pallets
  - 42W x 50L x 54H
  - 2600#
  - On pallets – 2”  
Over Hang
- Units by Weight:  
 $150,000/2600=57$
- Units by Cube - Pts:  $606/42 = 14$  Stacks;  $56 \times 2 = 108$  so 2 High; 2 high x 2 wide x 14 stacks= 56 Units
- Unfilled Space Pallets:  $14 \times 42 = 588$ ;  $606 - 588 = 18$  Lengthwise;  $50 \times 2 = 100$ ;  $114 - 100 = 14$  Lateral

# Design the Load Plan

- Draw the Boxcar - #10 w/Pallets
  - RBOX has 12' Single Sliding Door – Standard Draft Gear
- Understand your product
  - Dehydrated Milk is expensive and Bags are subject to tearing
  - Bags are Fluffy and Pliable – fill in pallet openings
  - Bags do not typically stack evenly and square
- Fill in the Units
  - Start with the Car Ends – working to the Doorway
  - Know your left over space and how to fill it.
  - 18" Lengthwise / 14" Lateral
- Fill in Securement Materials



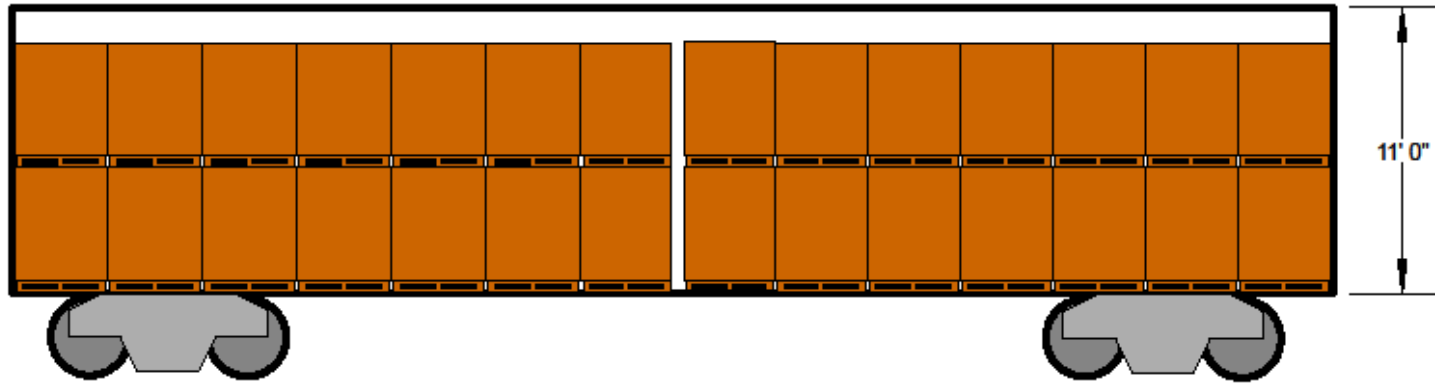


# Design the Load Plan

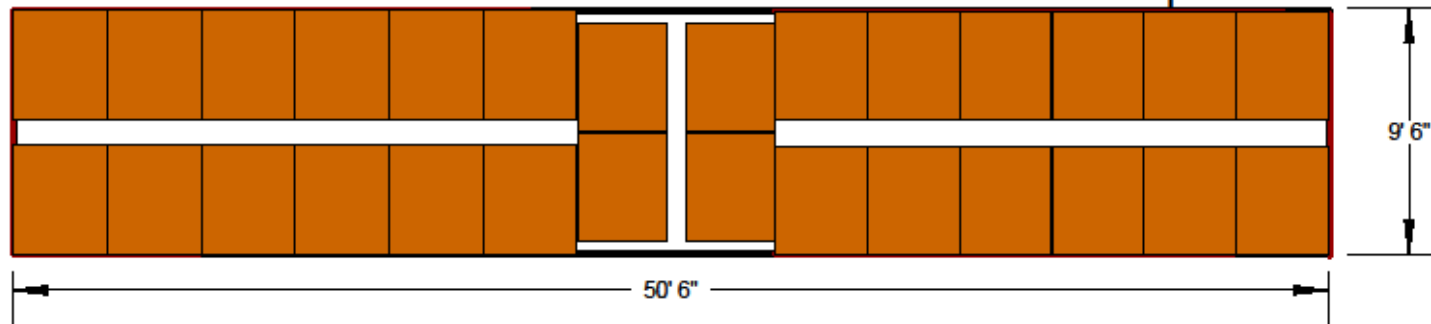


50 Kg Bags - 56 Pts  
50' RBOX

Side View



Top View



# Design the Load Plan

- Prep Car Side Walls and Backside Doorway
- Sliding Door requires Doorway Protection
- Lengthwise – 18” – Greater than 12” – Turn units the minimize Space – void reduced to 2” Air Bag to Tighten and Fill void
- Protect Bottom Pallet from Top Pallet – Panel between Units
- Buffer Air Bag from Pallets – Corrugated Sheet
- Lateral – 14”
  - Units are not perfectly square
  - Allow a extra room
  - 8/10” Center Void Fillers
  - w/Extra Wide Hanger



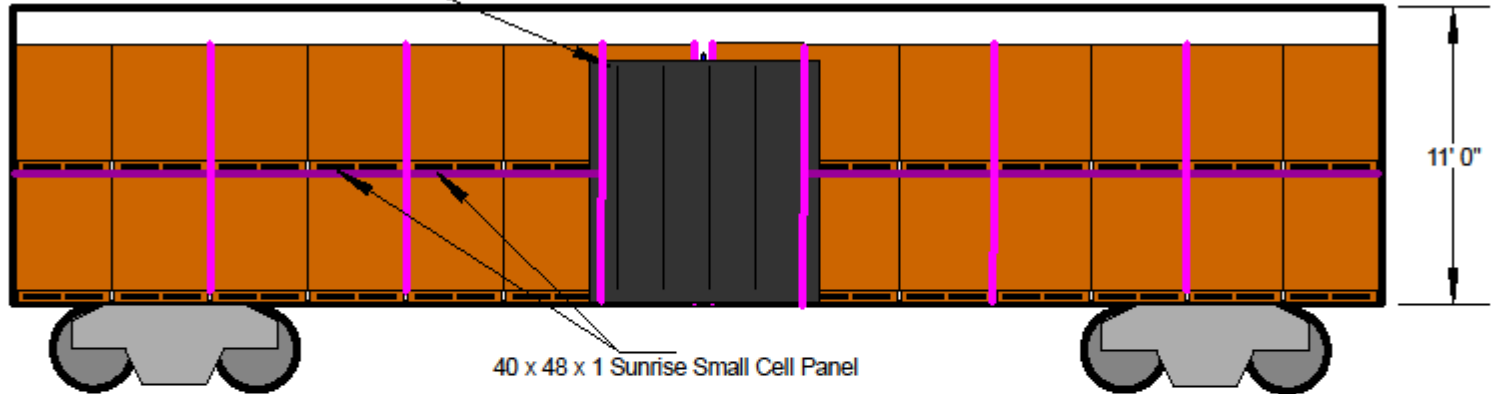
# Design the Load Plan



50 Kg Bags - 56 Pts  
50' RBOX

90 x 120 x 4  
LD Diamond-Pak Bulkheads  
as Door Protection

Side View

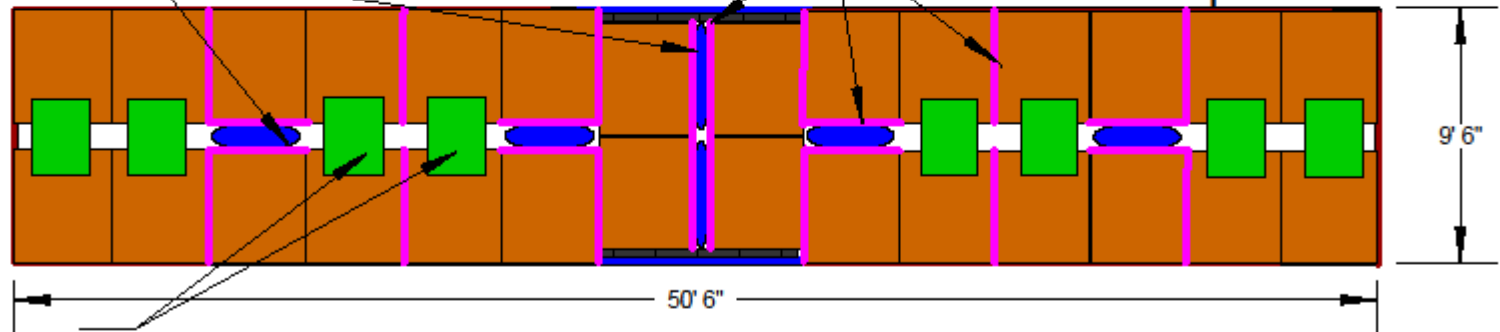


40 x 48 x 1 Sunrise Small Cell Panel

48 x 108 x L4 Air Bag

48 x 108 x 51 ECT DW Sheets

Top View



96 x 8 w/Extra Hgr  
DIAMOND-CORR Void Filler

Note: Walls are lined with SF Paper  
Doorway Strapping Applied

# Design the Load Plan

## Example 3 – Cheese Barrels

### ❖ Do the Math

- 64' Refer – 108W x 768L x 141H X  
180,000 Wt – 12'  
Single sliding door
- Cheese Barrels 4  
Per Pallet
  - 48.5W x 48.5L x 40H
  - 2300#
  - On pallets – 1/2" x 8-1/2" Over Hang

- Units by Weight:  
 $180,000/2300=78$
- Units by Cube - Pts:  $768/48.5 = 15$  Stacks;  $40 \times 3 = 120$  so 3 High; 3 high x 2 wide x 9 stacks= 54 Units; 2 High x 2 Wide x 6 stacks = 24 units = total 78 units
- Unfilled Space Pallets:  $15 \times 48.5 = 727.5$ ;  $768 - 727.5 = 40.5$  Lengthwise;  $48.5 \times 2 = 97$ ;  $108 - 97 = 11$  Lateral

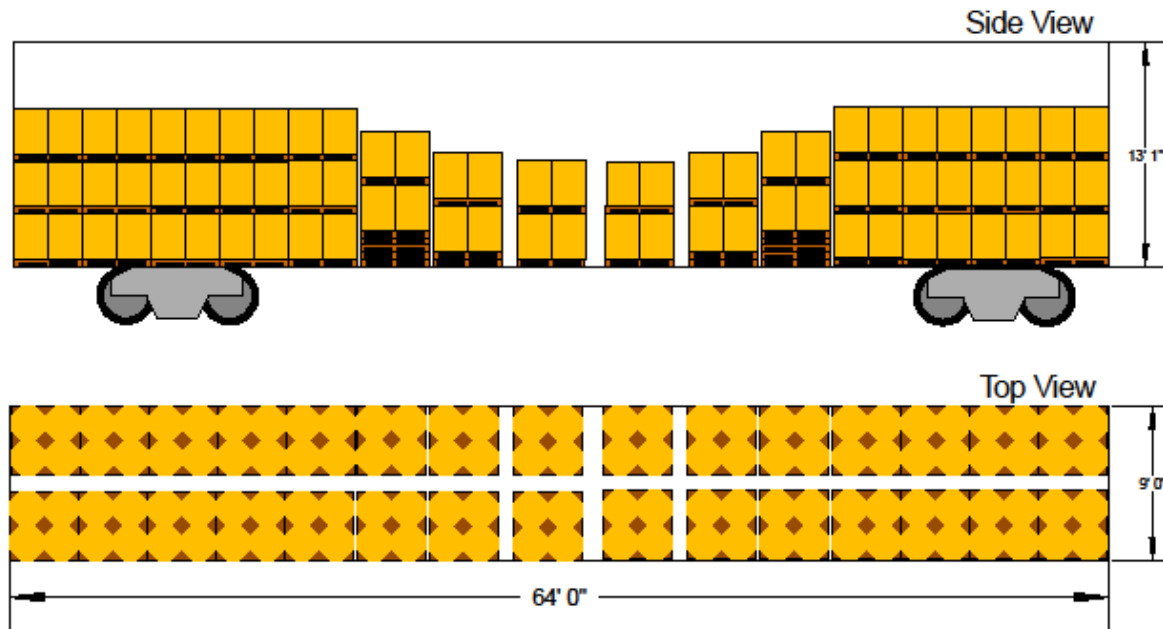
# Design the Load Plan

- Draw the Boxcar – 4 Barrels/Pallet – Octagon Shape
  - Vertically banded both directions
  - Add belly band at 3 High positions
- Understand your product
  - Difficult to damage
  - Extra care on Step Downs
  - Band Empty Pallets together for step down
- Fill in the Units
  - Start with the Car Ends – working to the Doorway
  - Know your left over space and how to fill it.
  - 40.5” Lengthwise / 11” Lateral
- Fill in Securement Materials

# Design the Load Plan



78 Pts - Barrel Cheese  
64' Refrigerated Car



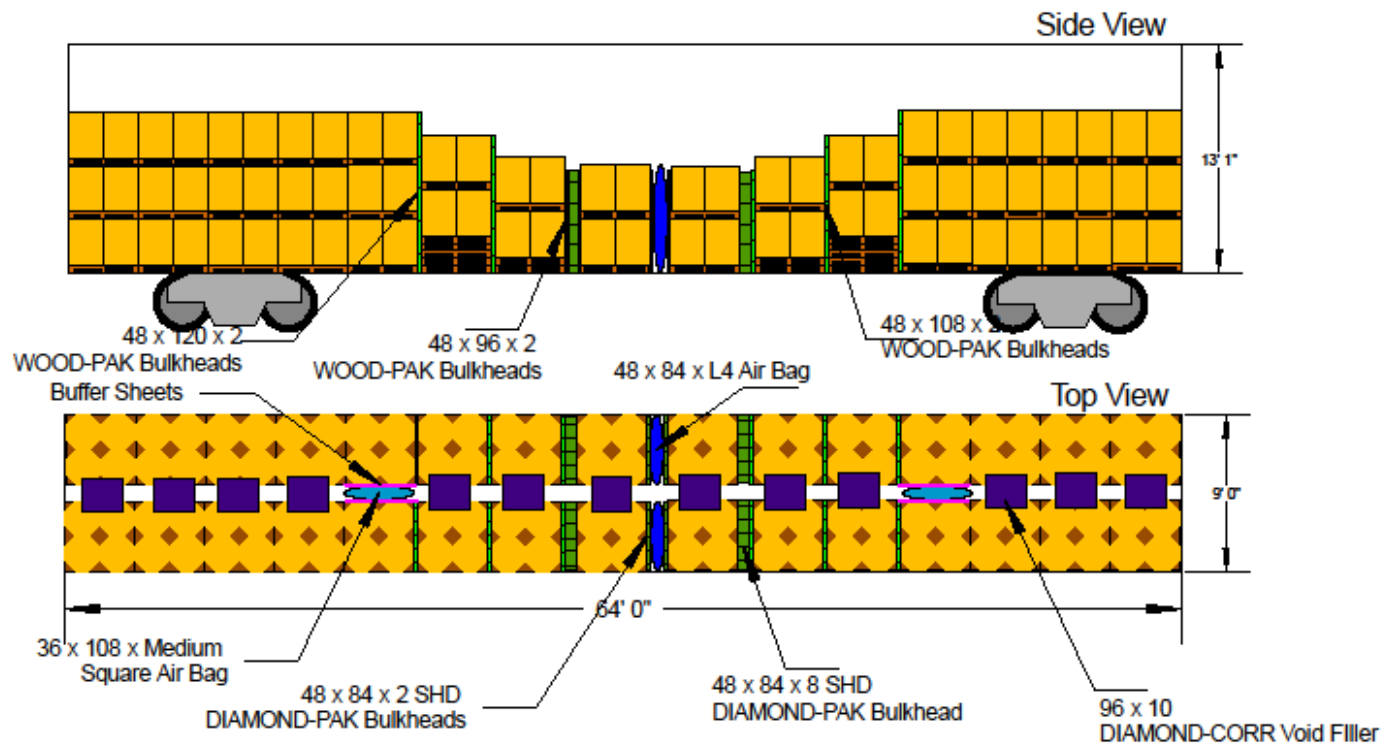
# Design the Load Plan

- Start at car ends – 3 high – Long end 5 Stacks; Short End 4 Stacks
- Step Down 3 Times using built up pallets
- Lengthwise – 40” – 2” Wood-Pak x 6; 8” SHD Bulkheads x 2; 2” SHD Bulkheads x 2 to Buffer air bags; 9” Air Bag Tighten and Fill void
- Lateral Air Bag at first step down for extra protection
- Lateral – 11”
  - 8/10” Center Void Fillers

# Design the Load Plan



78 Pts - Barrel Cheese  
64' Refrigerated Car

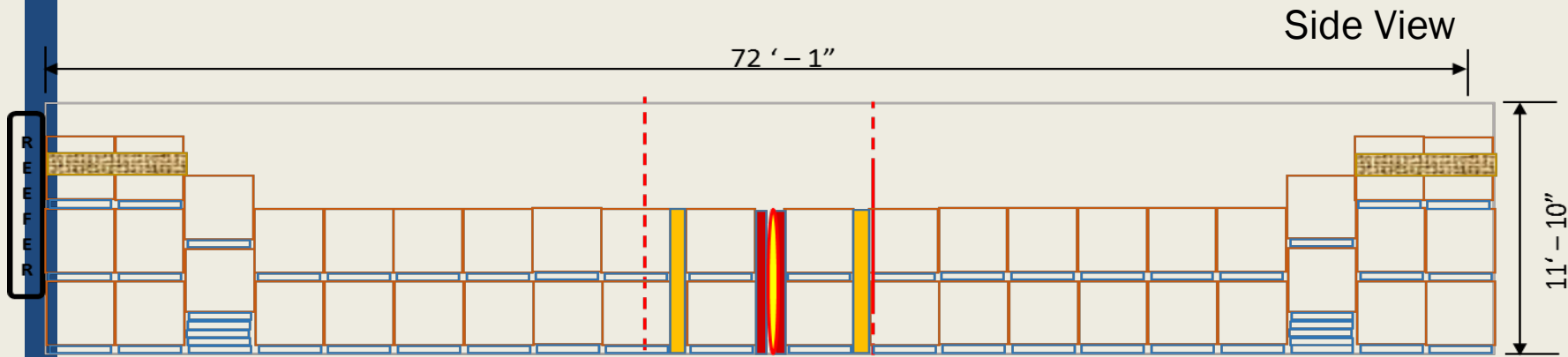









# Test Loads

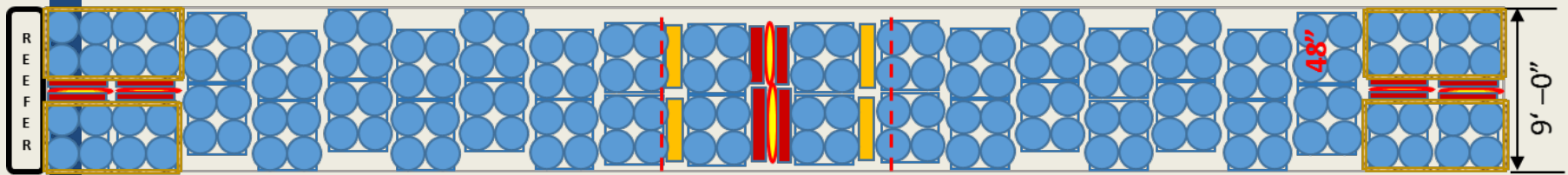
- ❖ Implement the plan
- ❖ Note deviations:
  - ❖ Problem areas
  - ❖ Changes to the plan
  - ❖ Take pictures
- ❖ Success or Failure does not necessarily mean the plan is a success or failure
  - ❖ Use Impact Recorder
  - ❖ Real World
- ❖ Systematically make changes
  - ❖ Control Variables

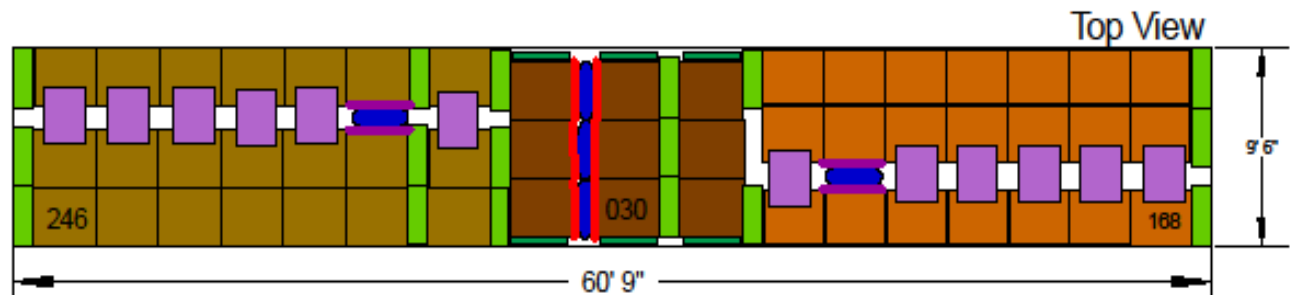
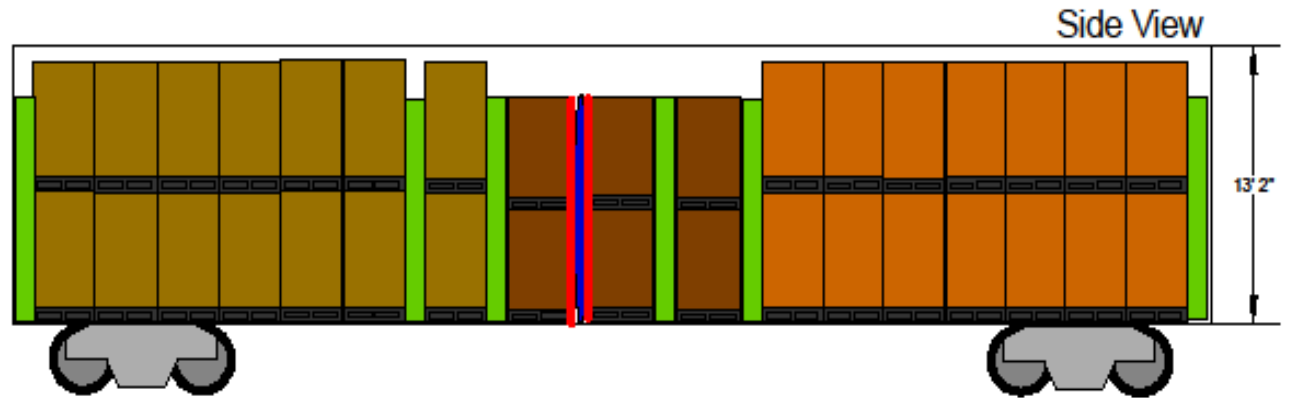
# SAMPLE LOAD PLANS



-  46.5" by 84" Level 4 Airbag (qty 2) as shown in top view
-  46.5" by 108" Level 4 Airbag (qty 4) as shown in top view
-  4" x 4' x 8' dunnage (qty 12) as shown in top view
-  6" x 4' x 8' dunnage (qty 4) as shown in top view
-  Tyguard strapping 2 pp deep x 2 pp wide

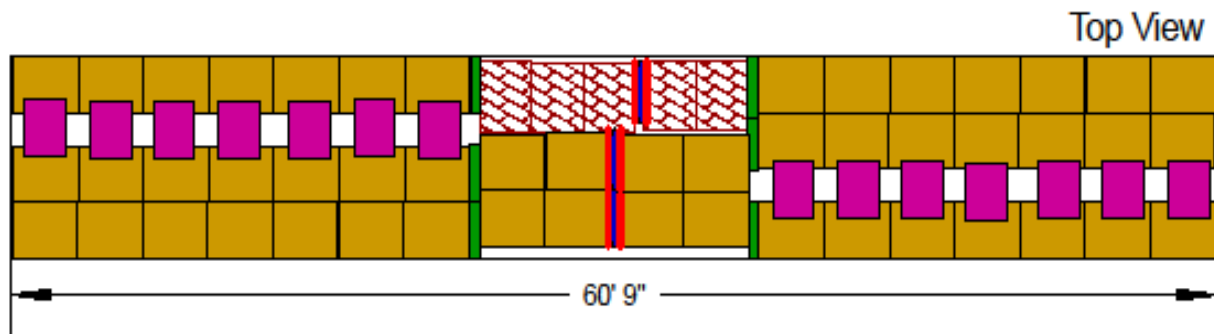
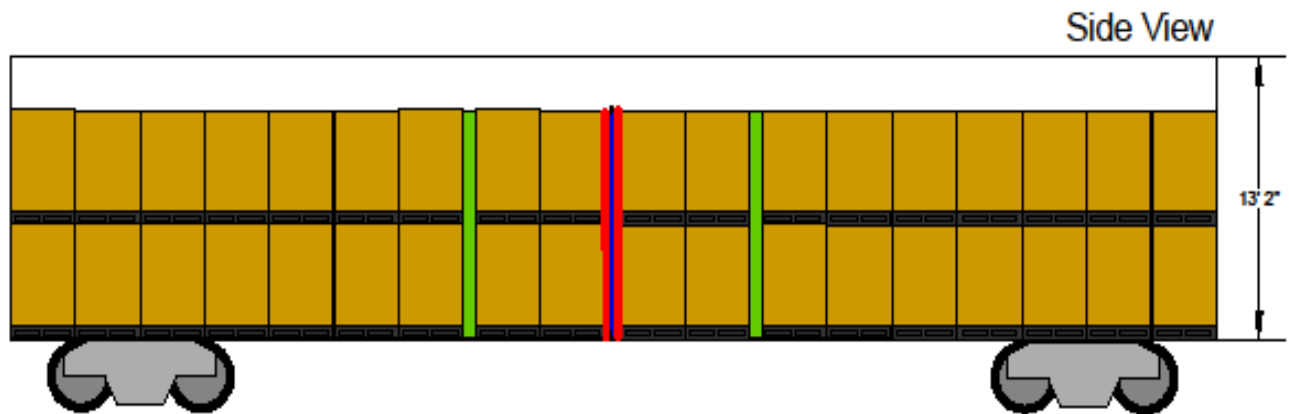
Top View








- 168 32" Across Car Width
- 246 32" Across Car Width
- 030 32" Across Car Width


- 6/8 - 32 x 136 x 4 SHD DPak
- 18 - 32 x 136 x 12 SHD DPak
- 10 - 32 x 130 #350 Sheets
- 5 - 36 x 136 Level 4 Air bags
- 12 - 108 x 12 Void Filler





 32" Across Car Width

 37" Across Car Width

 6 - 32 x 136 x 6 SHD Diamond-Pak Bulkheads

 3 - 36 x 136 x Level 4 Air Bags

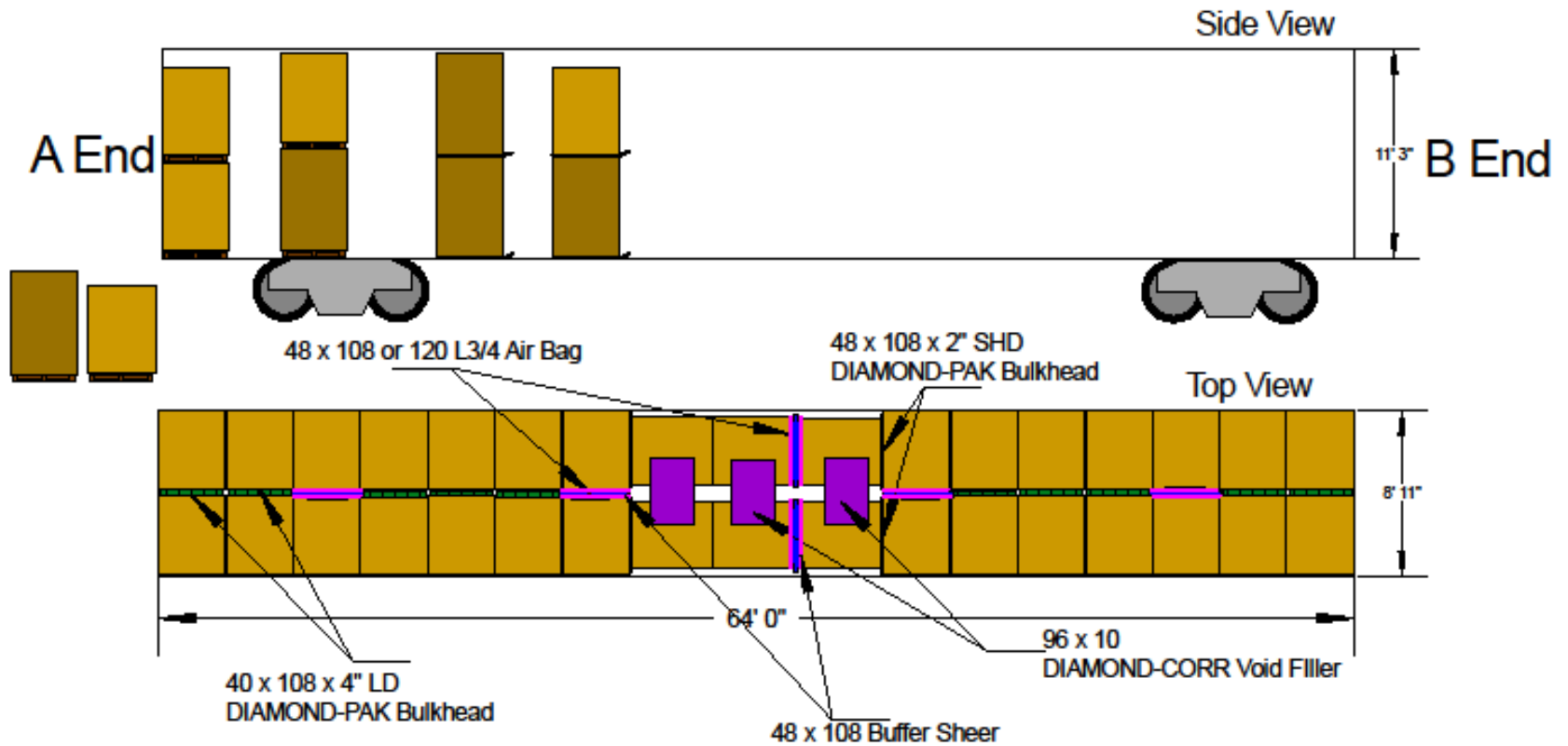
 14 - 108 x 16 Diamond-Corr Void Filler

 6 - 32 x 136 350# D/W Sheets



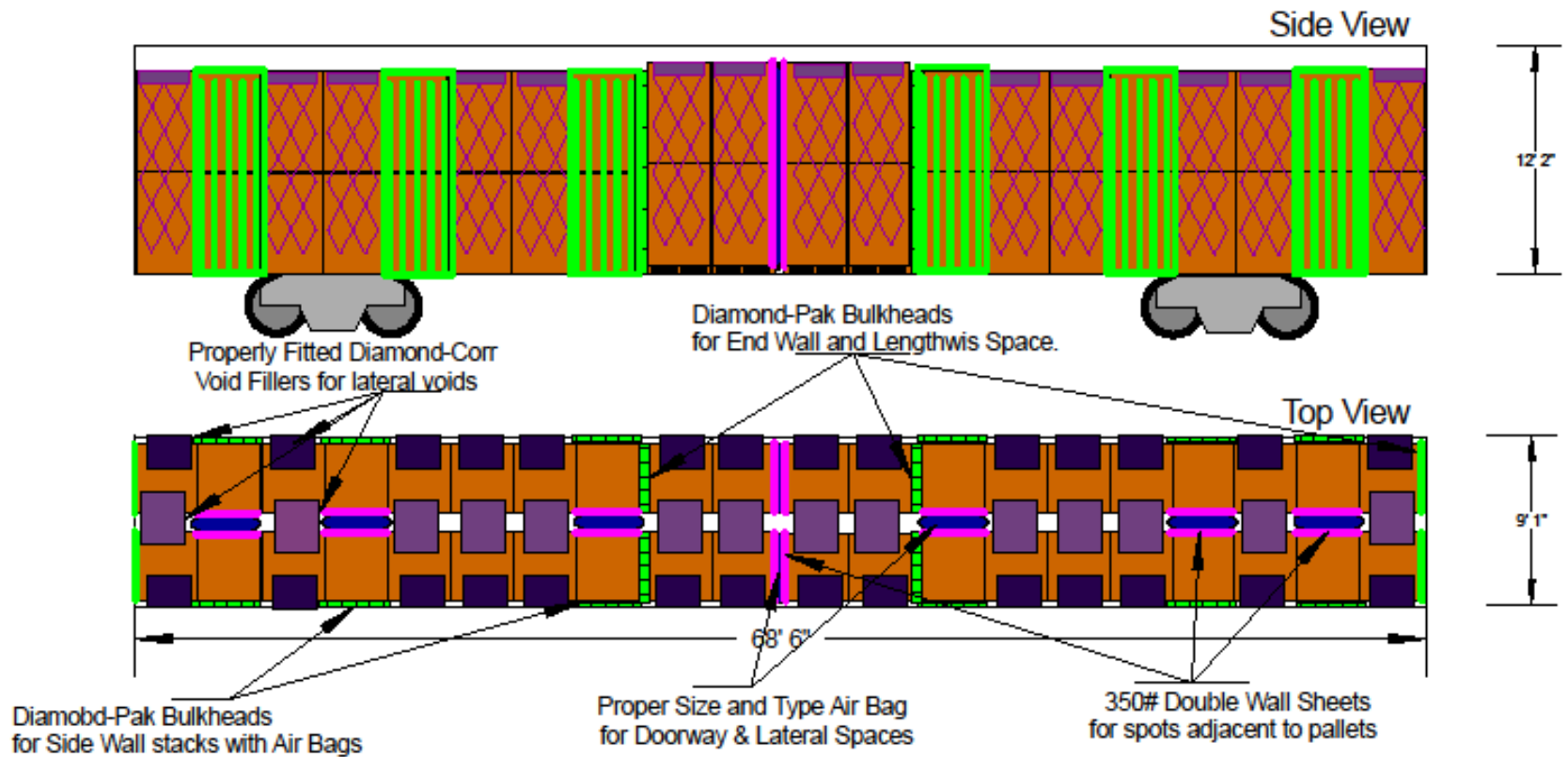
SUNRISE-MFG-INC

### 68 Pallets - Double Stacked CRYX 64' - 3000 Series





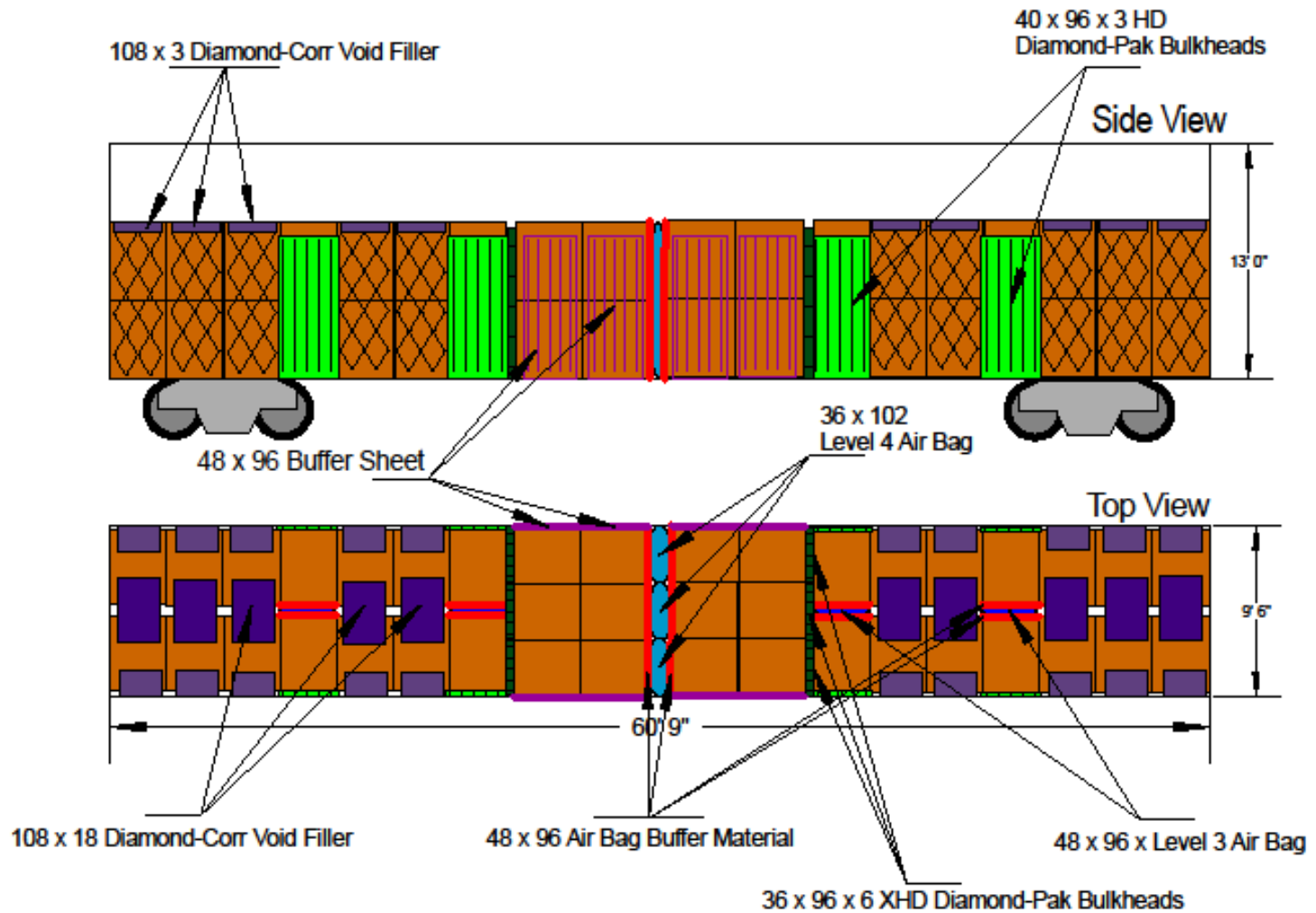
# 68' Insulated Boxcar Basic Load Pattern - Clamped





SUNRISE-MFG-INC

60' - TBox - 80 Pts.

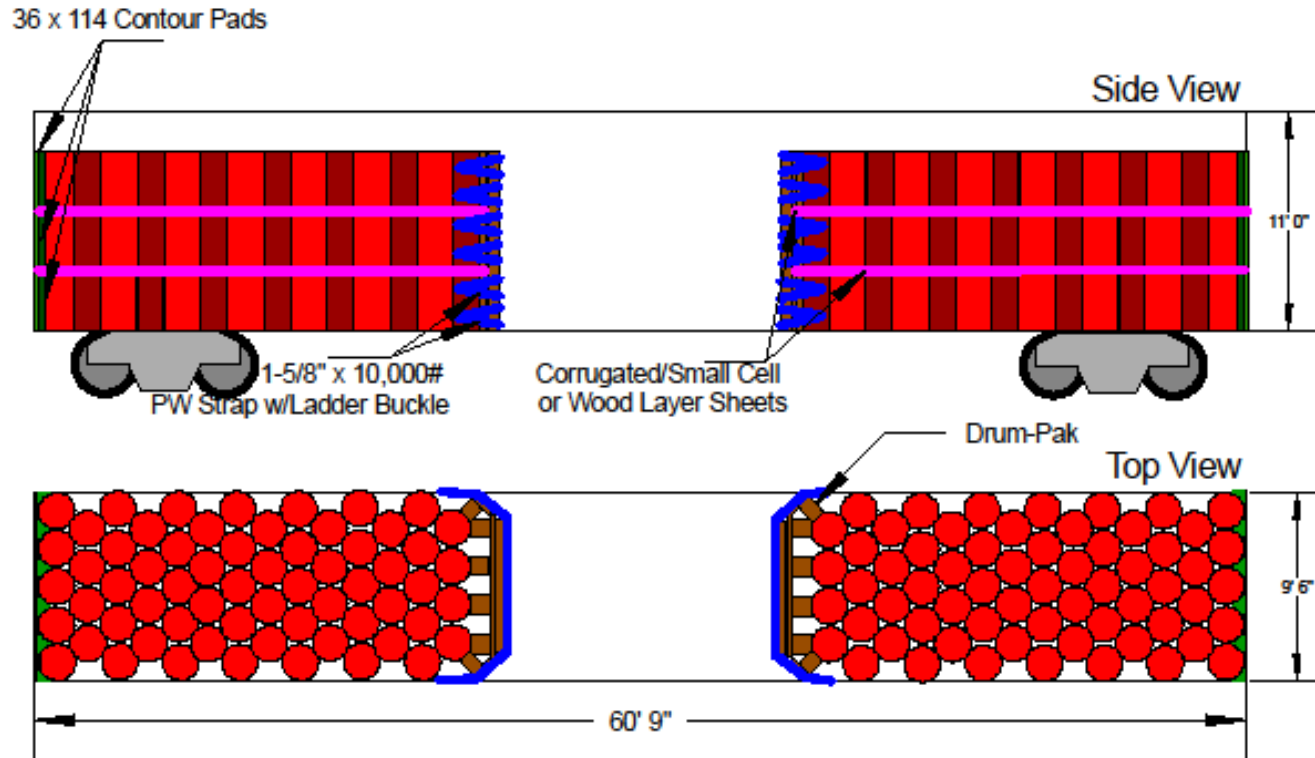






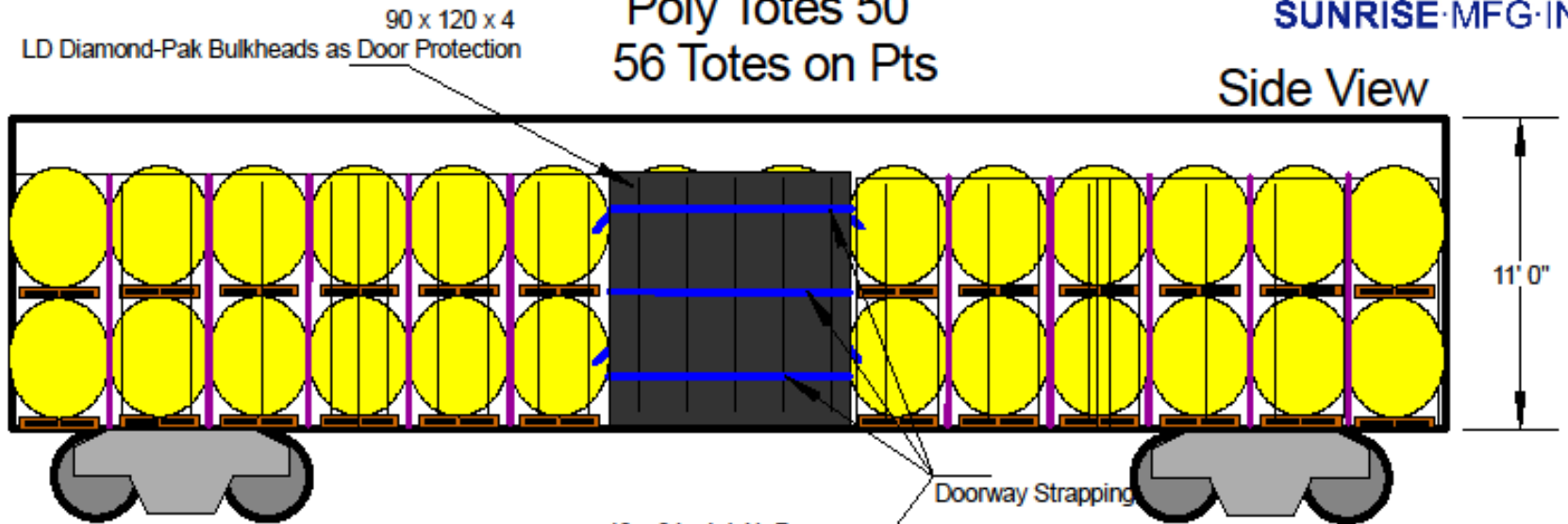
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# 60' Drums 3 High 378 Drums

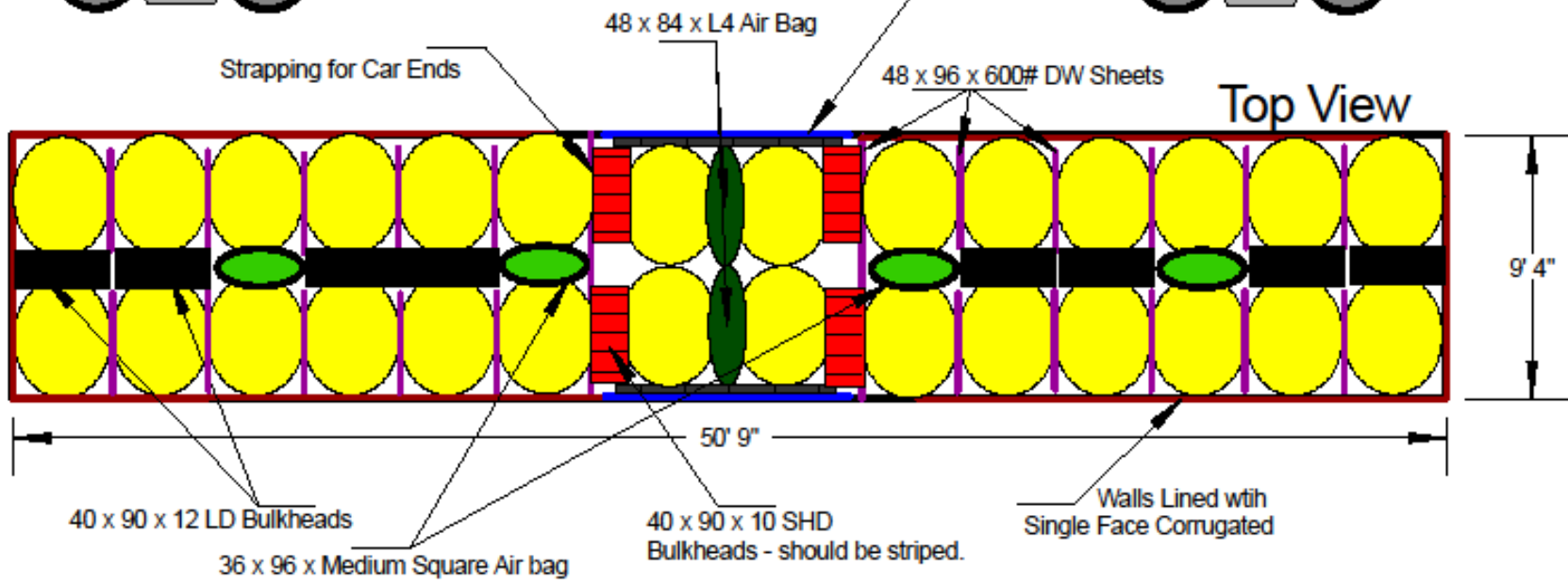


Poly Totes 50'  
56 Totes on Pts

Side View



Top View



Revised 3/7/16

# Questions?

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