SAND2011-2968C

Material Handling

Conex Mountain

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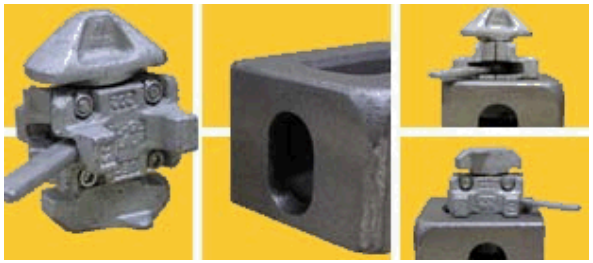
What is a Conex?

- Conex box (Army term- ***Con***tainer ***Ex***press),
  - Other names: Intermodal container (IMC), Sea Can, International Organization for Standardization (ISO) shipping container
- Seventeen million Conexs in use worldwide
- Standardized sizes 8’ x 8.5’ x 20’- 40’
- Can be stacked up to 7 high
- Each fitted with eight ISO corner castings for twist-lock fasteners



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What is a Conex? (continued)

- Some fitted with forklift slots (usually for moving when empty only)
- Doors on one end
- Constructed of corrugated weathering steel
  - A group of steel alloys which eliminate the need for painting

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Conexs at an Ocean Port

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Container Ship (> 7,000 Conexs)

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Conex Mountain (example)

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Conex Mountain

- Project "Build a Conex Mountain"
  - Assemble and stack 75 Conexs
    - 75 + Conexs available
    - Empty weight 5,000 lbs each
    - Conex dimensions- 8' wide x 8.5' high x 20' long
    - Conex mountain
      - Configuration - 5 wide x 5 high x 3 long
      - Final dimensions - 40' wide x 42.5' high x 60' long

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Conex Mountain Assembly Site
Concrete Slab 120’ x 120’

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Conex Mountain

Container Handlers

- **Specialized container handlers: (not available in NM)**
  - **Gantry Cranes**
  - **Boom type container handlers**
  - **Special container handlers (Forklifts)**

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Typical Conex Handling
Gantry Cranes

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Container Handling Equipment Available in NM

- Crane (mobile)

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Container Handling Equipment Available in NM - Crane

Crane experience - very comfortable with crane hazards and controls

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Using Crane to Assemble Conex Mountain

- Understand crane risks, hazards and controls
- Good on-site experience (no accidents)
- Cranes operated safely within manufacturers' design parameters
- Project
  - Requires large crane to reach over 42.5' high Conex mountain
  - Forklift to shuttle containers
  - Aerial boom lift (disconnect rigging)
  - Personnel needed (riggers, crane operator, forklift operator, signalmen, etc.)

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Using Crane to Assemble Conex Mountain (continued)

- Wind, weather
- Alignment and control problems (tag lines)
- Specialty rigging (minimum 45 degrees sling angle)
- Employee fall hazard exposures: rigging container (ground level, disconnecting at elevation, installing bridges)

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Container Handling Equipment Available in NM - Forklift

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Container Handling Equipment Available in NM - Hyster 550HD

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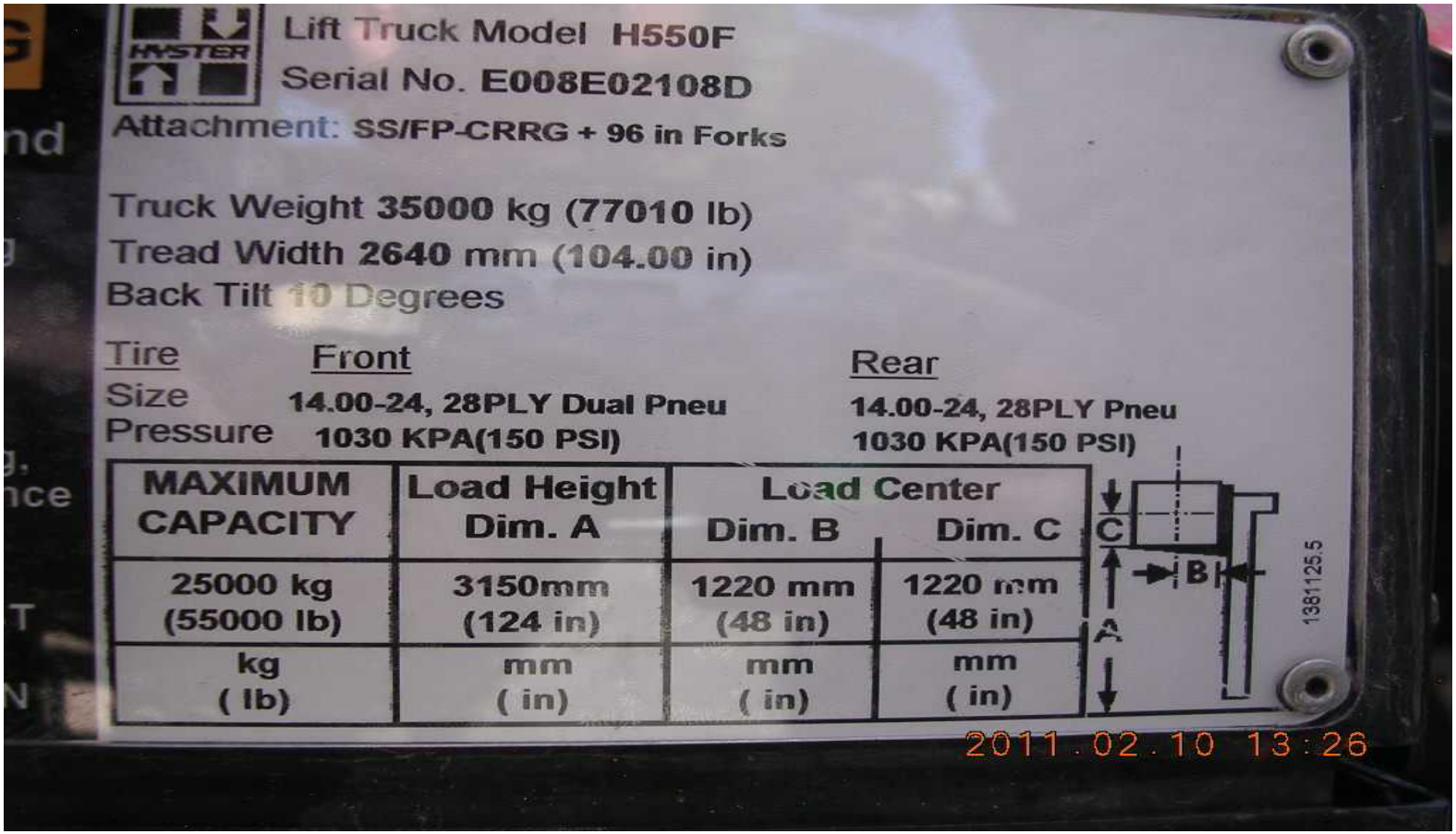
Data Plate
Hyster 550HD



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Forklift Physics Review
Odie vs. Garfield

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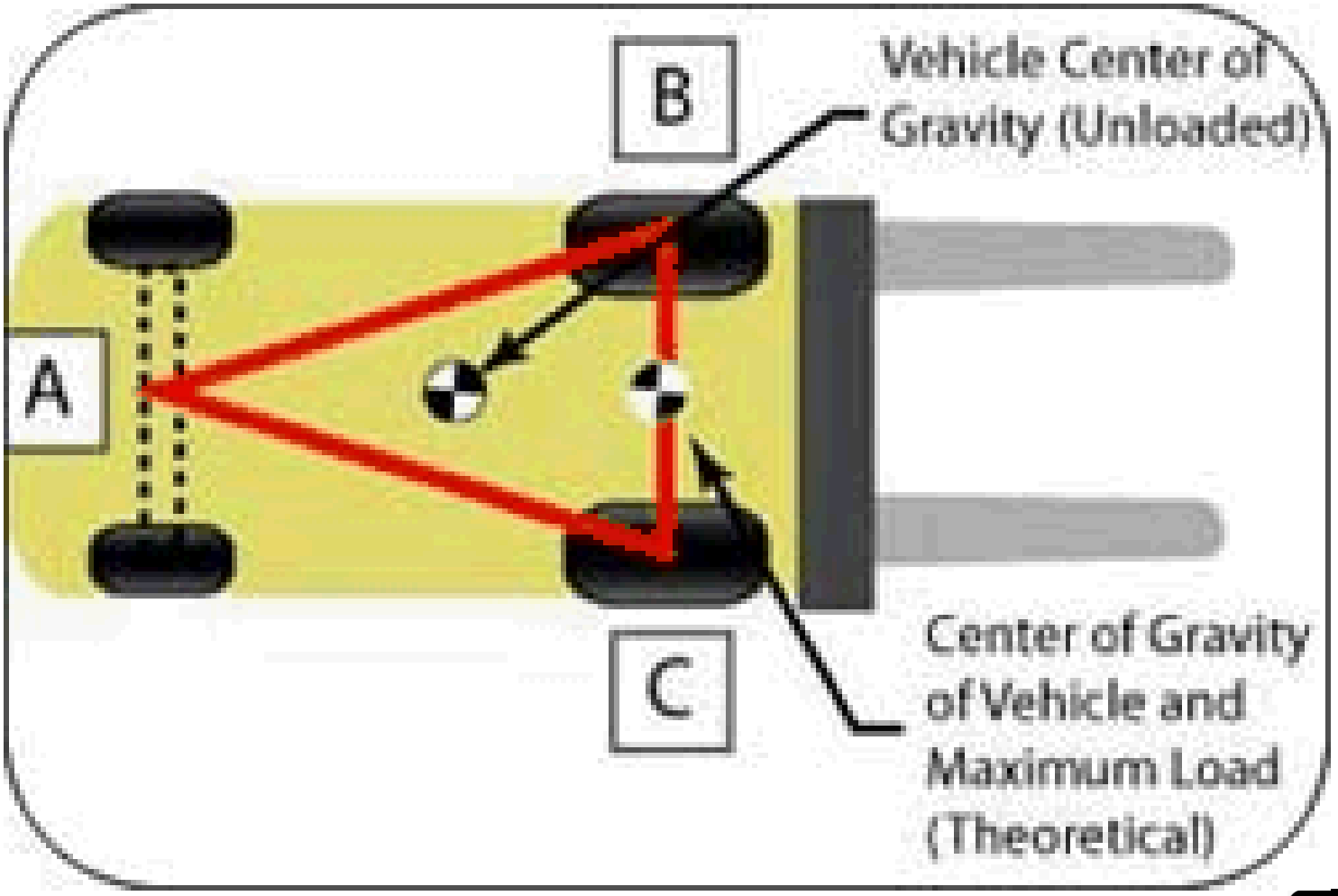
Forklift Physics Review



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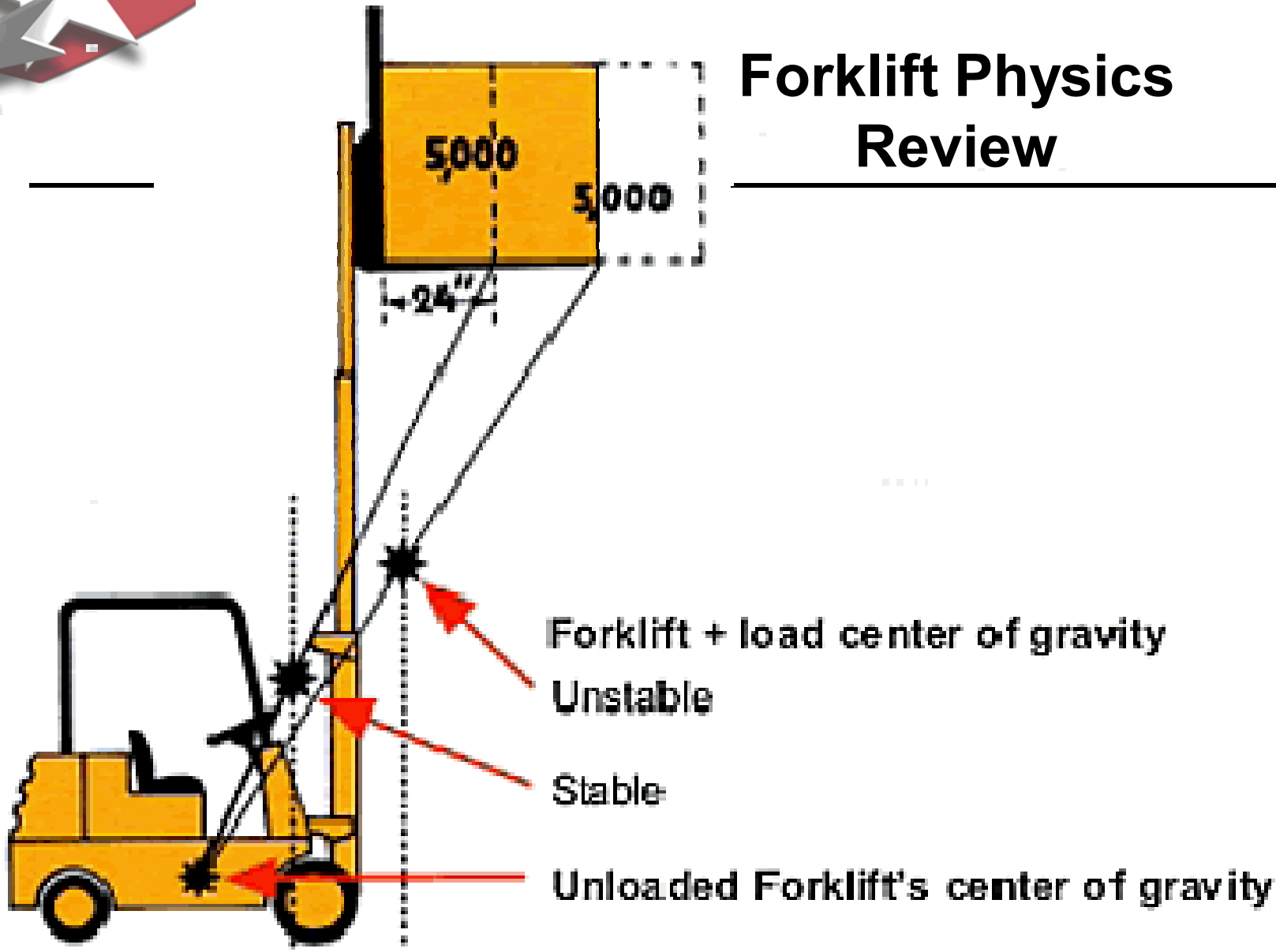
Forklift Physics Review



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Hyster 550HD Forklift

- Capacity 55,000 lbs
  - Total weight (4 Conexs) 20,000 lbs.
- Forklift weighs 77,000 lbs
    - Truck and lowboy to move
- Load center (LC) 48” horizontal/vertical
- Max lift heights 124” = 10’4 “

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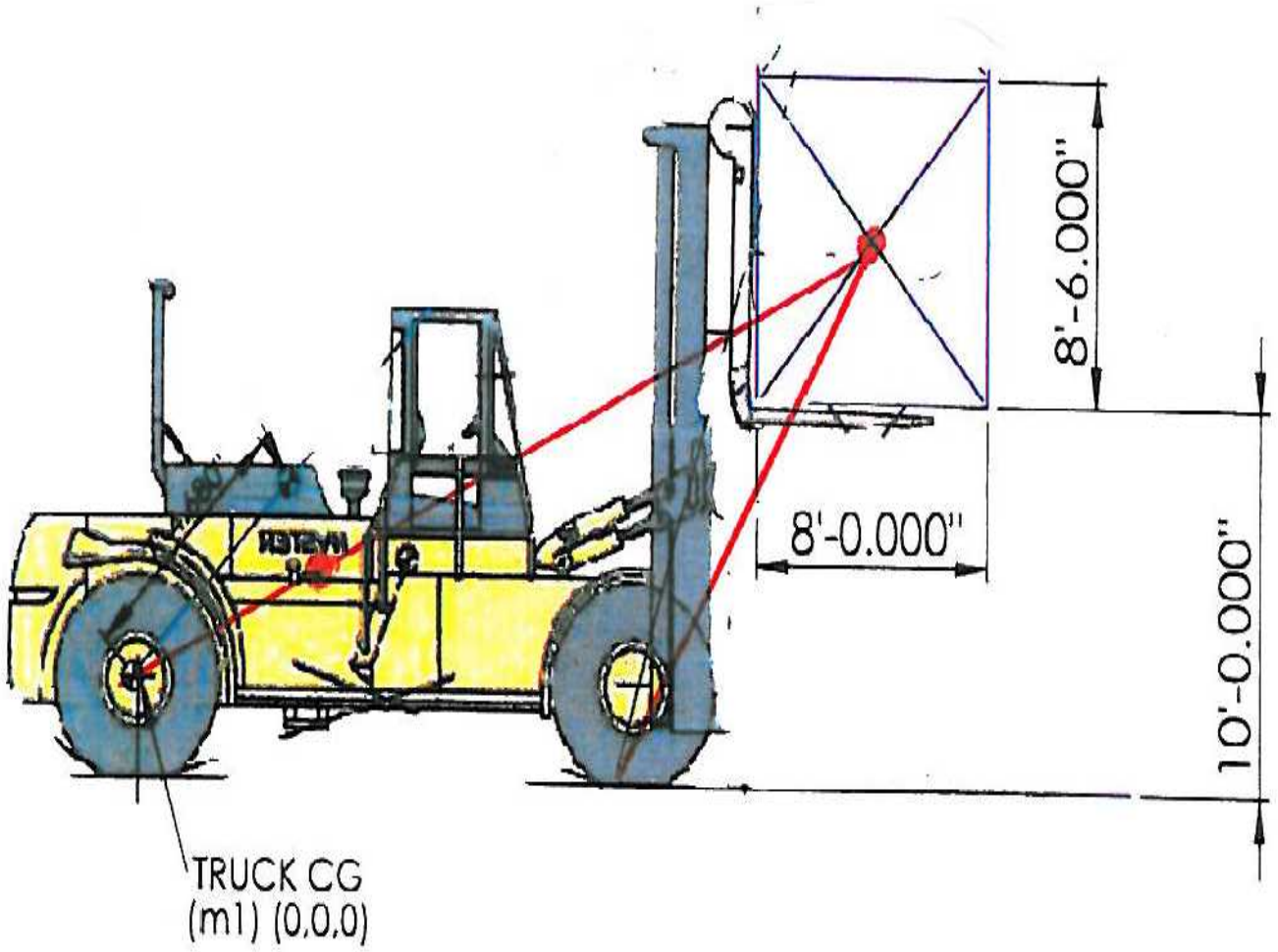
Hyster 550 HD
CG, Load CG, and CCG



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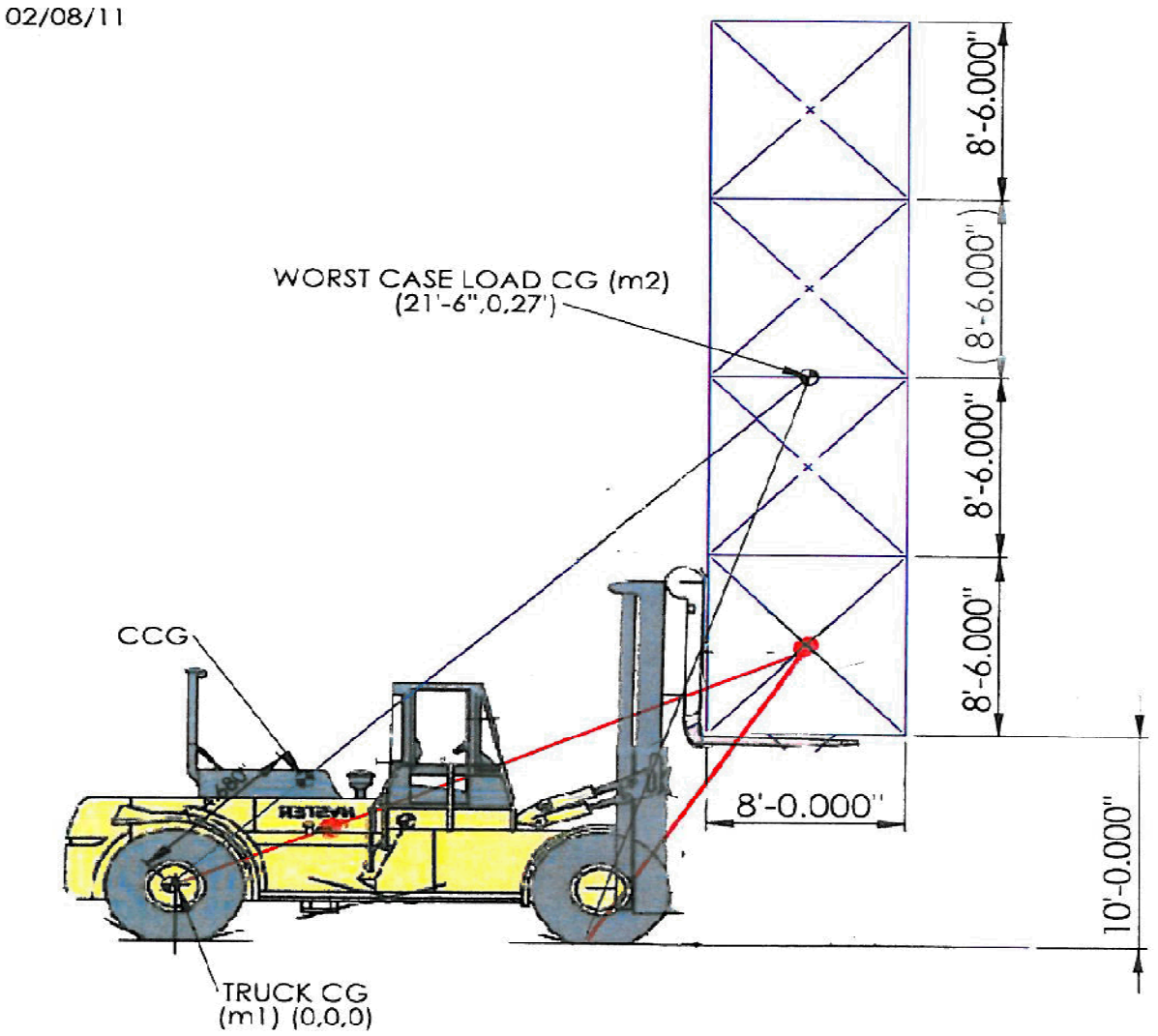
Hyster 550 HD
Worst Case CCG-4 Conexs



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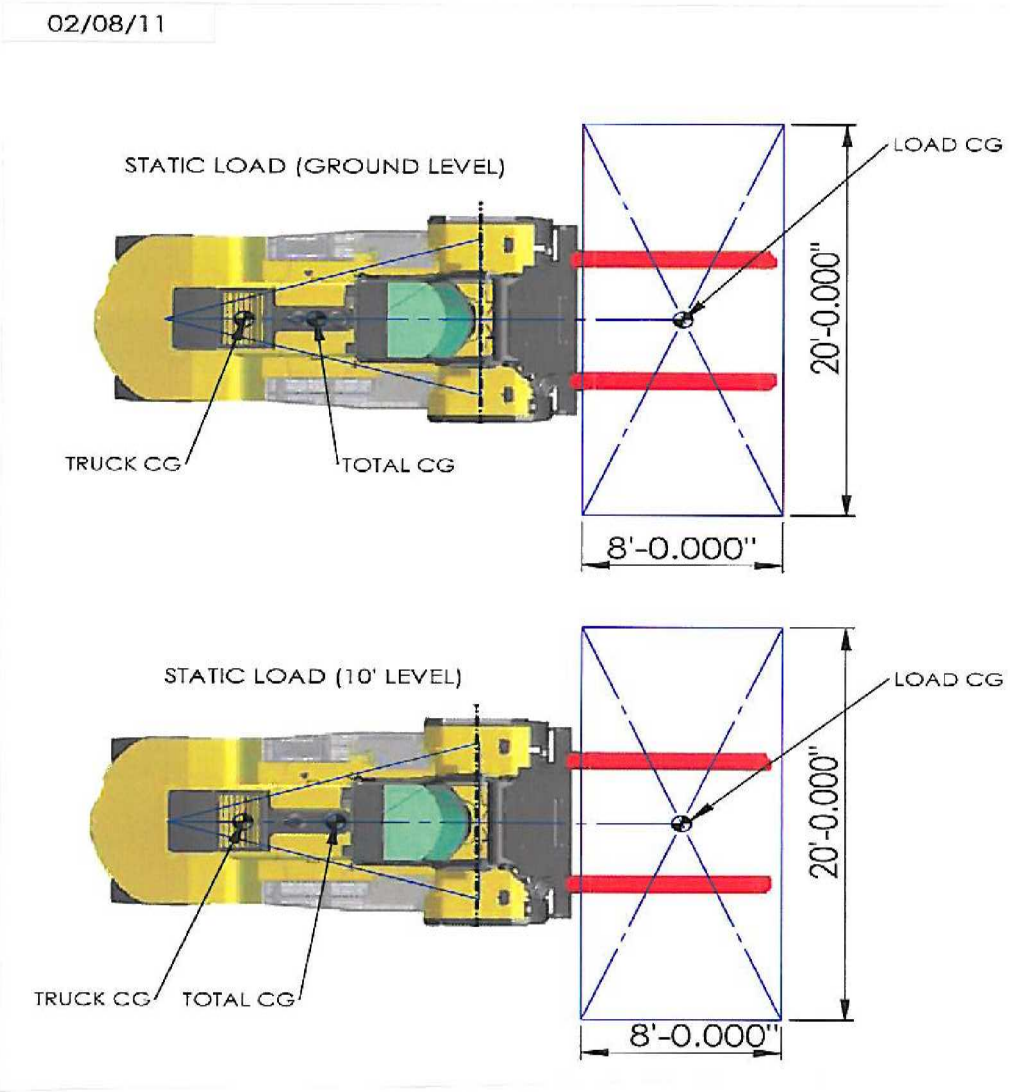
Hyster 550HD
Top View with Conexs



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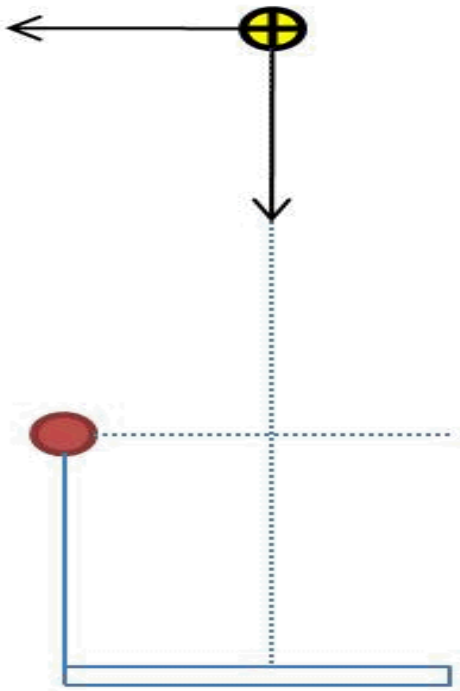
Pivot Arm Math



$m_1 := 2000\,\text{lbm}$

$F_2 := 2000\,\text{lbf}$

$\text{Pivot} \equiv 75.5\,\text{in}$

$\text{Moment\_Arm}_1 := 17\,\text{ft} - \text{Pivot}$

$\text{Moment\_Arm}_1 = 10.708\,\text{ft}$

$\text{Moment\_Arm}_2 \equiv 4\,\text{ft}$

$\text{Torque}_2 := \text{Moment\_Arm}_2 \cdot F_2$

$\text{Torque}_2 = 8 \times 10^4\,\text{ft-lbf}$

$$a_1 := \frac{\text{Torque}_2}{\text{Moment\_Arm}_1 \cdot m_1}$$

$$a_1 = 12.018\,\frac{\text{ft}}{\text{s}^2}$$

40 mph in 5 seconds

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Safety Regulations: OSHA

1910.178(a)4

Modifications and additions which affect capacity and safe operation shall not be performed by the customer or user without manufacturers prior written approval. Capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly.

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ANSI/ITSDF B56.1-2009 Safety Standard for Low Lift and High Lift Trucks

5.4.1 Handle only stable or safely arranged loads

(a) When handling off-center loads that cannot be centered, operate with extra caution

(b) Handle only loads within the capacity of the truck

(c) Handle loads exceeding the dimensions used to establish truck capacity with extra caution. Stability and maneuverability may be adversely affected.

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Manufacturer (Hyster) Approval

"This unit has the capacity to pick 4 containers locked together as described. It is expected that forks will be inserted into fork pockets in the containers to prevent them from sliding. Caution also should be exercised regarding environmental conditions—wind, ground conditions, and speed."

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Structural Engineer's Analysis

- The engineer's modeling analysis indicates:
  - The forklift can handle the load moments imposed by lifting and moving the four (4) containers
    - Not moving a (4) stack in winds > 5 mph
    - Operating the forklift slowly
    - Not hitting any obstructions
  - Pivot point
    - Acceleration < 12 ft per second/second or 40 mph in 5 seconds!!

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Conex Lift and Movement Controls

- Contractor experienced and confident
- Observed successful trial lift
- Safety and lift plan developed,
  - including (critical lift data sheet)
- Engineering analysis
- Manufacturer's approval
- Training
- Homogenous load—all containers locked together with twist locks during movement

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Conex Lift and Movement Controls (continued)

- Positive control of container (forklift pockets)
- Lifting load < 10’ eye level better control
- Slow movements
- Flat concrete surface
- 77,000 lb diesel forklift (overwhelms containers)
- Wind, Weather
- Limited number of personnel and exposures
- Spotters/riggers
- Using previously stacked back-up containers to provide support

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Solution Slides

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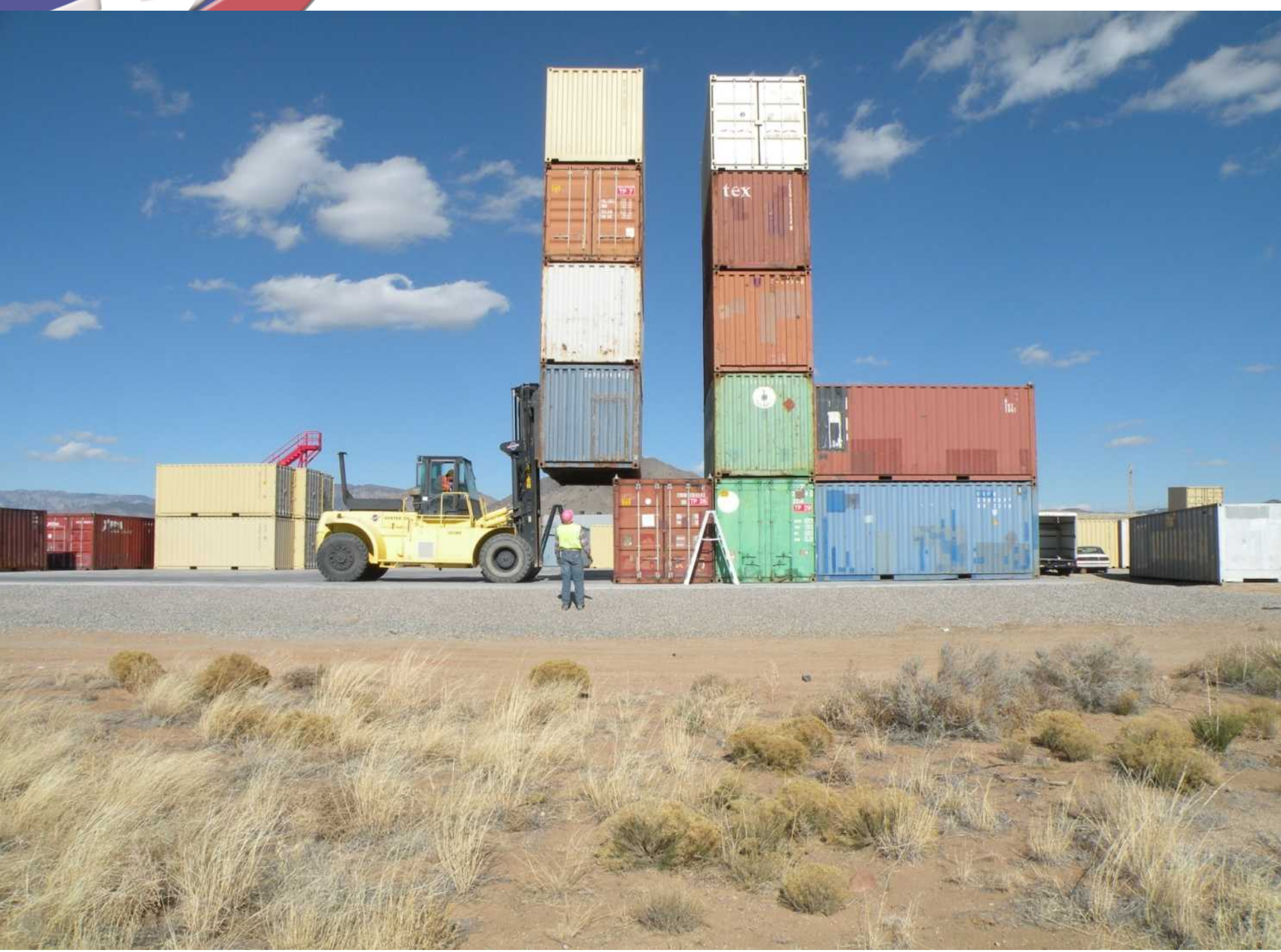
HYSTER 550
EVERGREEN
TRITON
XTRA


tex


tex
TP 7
TP 28
TP 29


tex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TRITON
EVERGREEN