



ILC DOVER
creating what's next

2017 Association of State Floodplain Managers Annual Conference:

Managing Flood Risk in the Heartland

April 30th – May 5th

Kansas City, Missouri

Development and Implementation of Dry Flood Proofing Stored at the Point of Use

ILC Dover LP

www.ilcdover.com



Dry Flood Proofing

- Dry Flood Proofing
 - Structure or device above the base flood elevation with a substantially impermeable barrier to prevent the ingress of water and debris
- Dry Flood Proofing Benefits
 - Other means such as elevating may not be feasible
 - Street access required into the building
 - Historic areas cannot be modified
 - Densely populated areas restricted on property uses
- Dry Flood Proofing Issues
 - Requires active deployment
 - Maintenance
 - Training
 - Storage/Transit for deployment





Resilient Tunnel Plug



**Homeland
Security**

Science and Technology



**Transportation
Security
Administration**

General system attributes

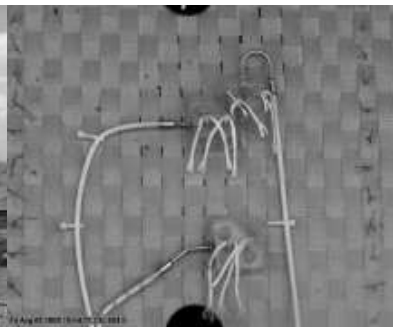
- Designed to rapidly isolate tunnel sections in response to flooding, smoke / fire, or release of CB agents (functions like an automotive airbag)
- Deployable plug technology
- Fixed in tunnel or transportable
- Frictional plug contours to irregular surfaces
- Robust design for challenging environments
- Very little tunnel modification required
- Scalable design (4ft to 16 ft dia tested)
- Verified to hold 38ft water head

Currently working 1st installation in US Transit system



Tunnel Plug Development

- ILC work with webbing based structures directly led to the development of the Resilient Tunnel Plug
- Webbing provide a redundant, resilient design that can withstand damage and impact
 - Explosive testing at White Sands demonstrated the minimal change in tension of the webbings due to friction
- Resilient Tunnel Plug took this design to the next level by creating a full webbing net structure





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Costliest U.S. Atlantic hurricanes

Cost refers to total estimated property damage

Rank	Hurricane	Season	Damage
1	Katrina	2005	\$108 billion
2	Sandy	2012	\$65 billion
3	Ike	2008	\$29.5 billion
4	Andrew	1992	\$26.5 billion
5	Wilma	2005	\$21 billion
6	Ivan	2004	\$18.8 billion
7	Irene	2011	\$15.6 billion
8	Charley	2004	\$15.1 billion
9	Rita	2005	\$12 billion
10	Frances	2004	\$9.51 billion

Source: National Hurricane Center^{[188][1][189][nb 1]}

Hurricane Sandy

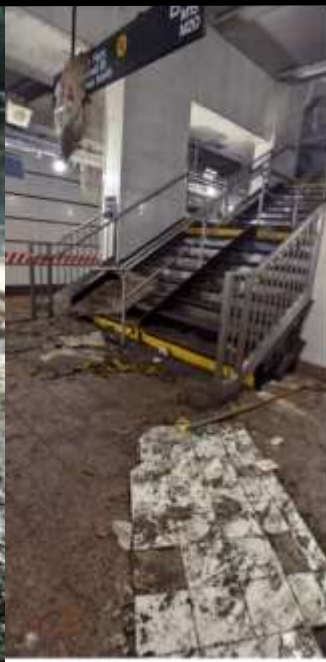
October 29th, 2012



Hurricane Sandy



148th St. Portal Flood Wall During Super Storm Sandy



NY MTA Deployment Demonstration South Ferry Station - NYC





Evaluation of Dry Flood Proofing

- Transit authorities, end users, commercial property owners, and flood experts all provided input on the key requirements for flood proofing
 - Easy to use
 - Minimal training
 - Intuitive system that people will use
 - Fast to deploy and fast to retract
 - Opening up a transit system is often just as critical as closing it down
 - Can be used multiple times
 - Technology can be used in different size and types of openings
 - It must be scalable to different head pressures and types of openings
 - Low cost

**Easy to use
system
that is
stored at
the point
of use**

Technology Overview

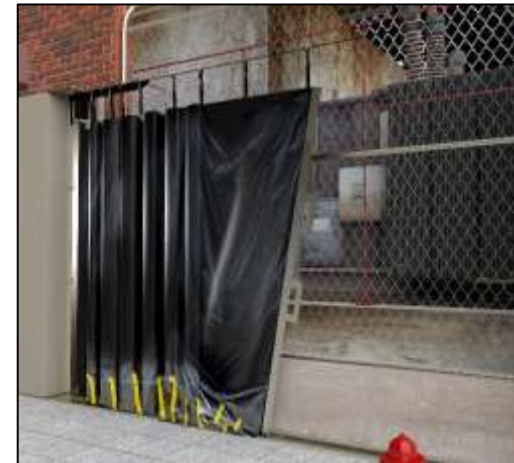
Enabling Technology for Flood Protection

- Textile/membrane structures can be **stowed in small volumes**
- Small stowage volume enables “**point of use storage**”
- Point of use storage enables **rapid deployment/retraction**
- Rapid deployment/retractions enables **cost & risk reduction**
 - Keep facility operational as long as possible
 - Minimizes productivity/safety impact
 - Reduces operational cost (storage/transport/# people)
 - No risk of lost parts in storage/transport
 - Simplifies training & yearly testing
- Minimal mechanical parts to reduce **maintenance time and cost**



Simple Intuitive Technology

- Deploys like roll-up doors, shower curtains, etc.
- Requires **minimal training**
- **Scalable** to any DFE and application (size & shape)



**Flexible Technology Products Provide the Lowest
Life-Cycle Cost Possible**

ILC Dover Flood Protection Products

Resilient Tunnel Plug



Plugs tunnels

Flex-Gate® Stairwell



Seals stairwells

**Vertically Deployed
Flex-Wall®**



Protects entrances / perimeters

Flex-Cover®



Seals vent shafts

Pipe Plugs



Plugs pipes

Flex-Gate® Portal



Seals vertical openings

Side Deploy Flex-Wall®



Protects entrances / perimeters

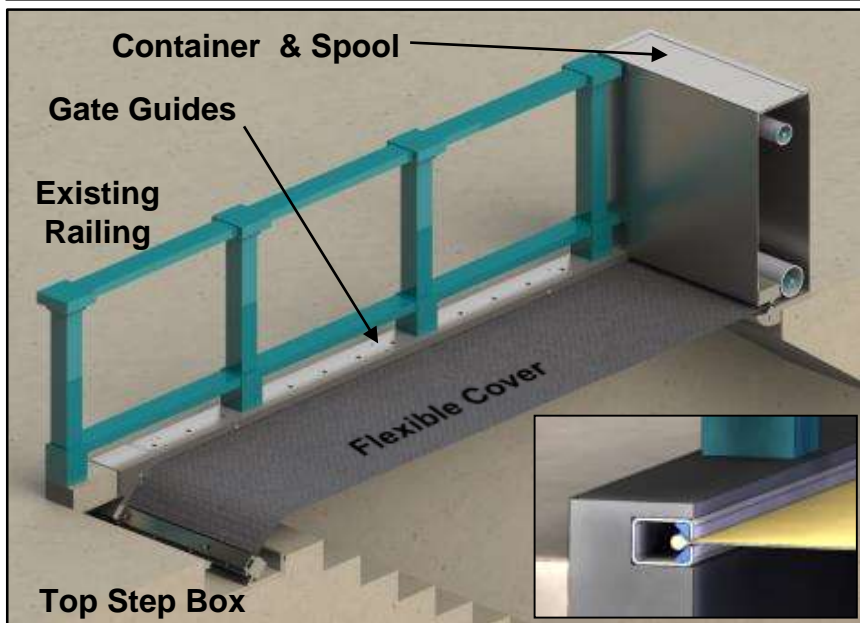
VaporGuard™



Fugitive emissions covers



Stairwell Flex-Gate®



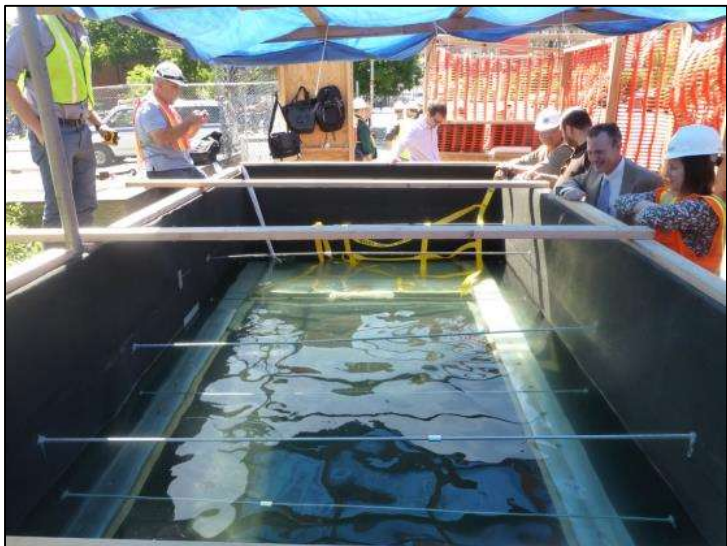
General system attributes

- Point of use storage
- Low maintenance (few moving parts)
- Self-contained system
- Simple operation
- Deploy in <5 min by 1 person
- 75 yr life (membrane replacement at 25 yrs)
- Withstand up to 14ft water head
- <0.5gal/min/ft perimeter seepage
- Stainless Steel / Kevlar / CSM
- Certified to NY MTA DG312
- Scalable design
- Can be operated in high winds
- Resists environmental & chemical exposure

24 Systems installed (Canal St. NYC) (8-Stations). Follow-on 8 & 9 Stations contracts pending (~66 total).



Stairwell Flex-Gate®

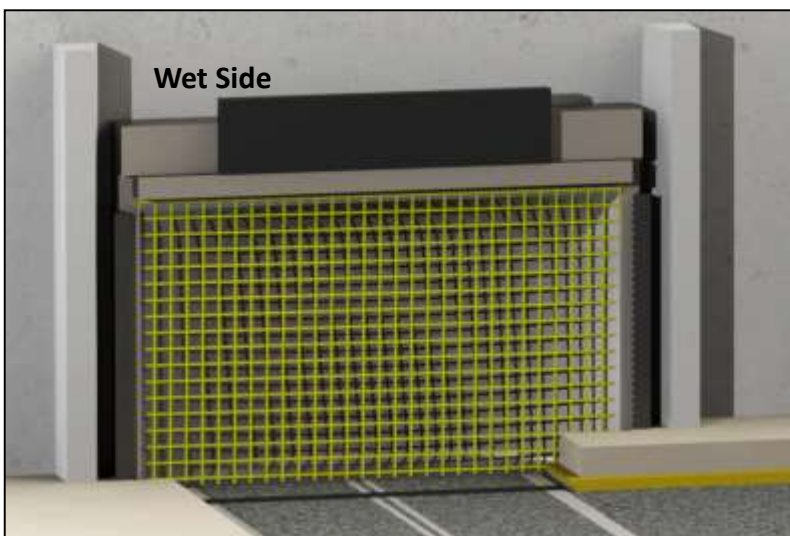


A deployed system in NYC

NYCT system testing



Portal Flex-Gate®



General system attributes

- Point of use storage
- Low maintenance (few moving parts)
- Closed and Opened by push-button drive motor
- Hand actuation capable in power outage situation
- Resist 35'+ of water
- Deploy in under 20 minutes (2 people)
- <0.5 GPM/ft of perimeter
- Can be operated in high winds
- Resists debris impact & hydrodynamic loading
- Can adapt to uneven ground surfaces or portal skew
- Can be faced to match architecture
- 25 year time between refurbishment
- Fire resistant (self-extinguishing materials)
- Resists environmental & chemical exposure
- Adaptable to signal cables
- Certified to NY MTA DG312

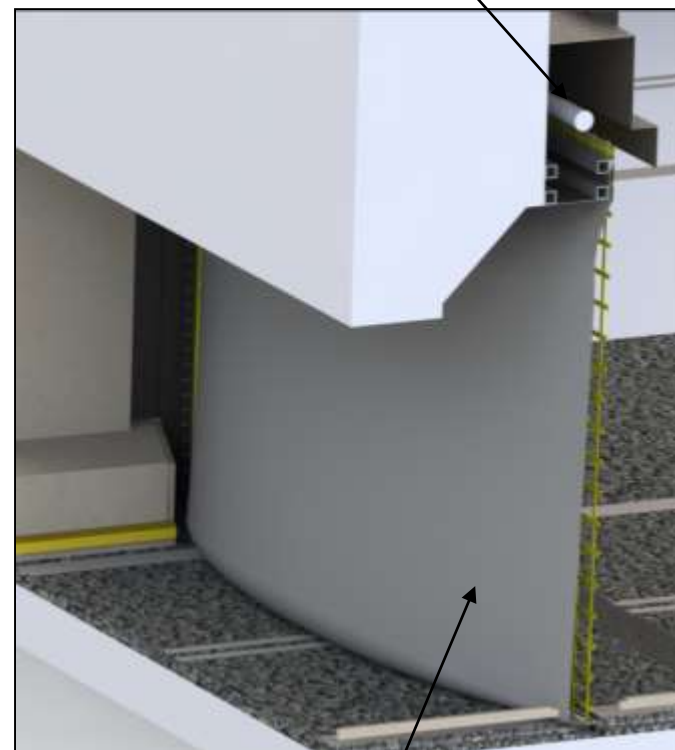
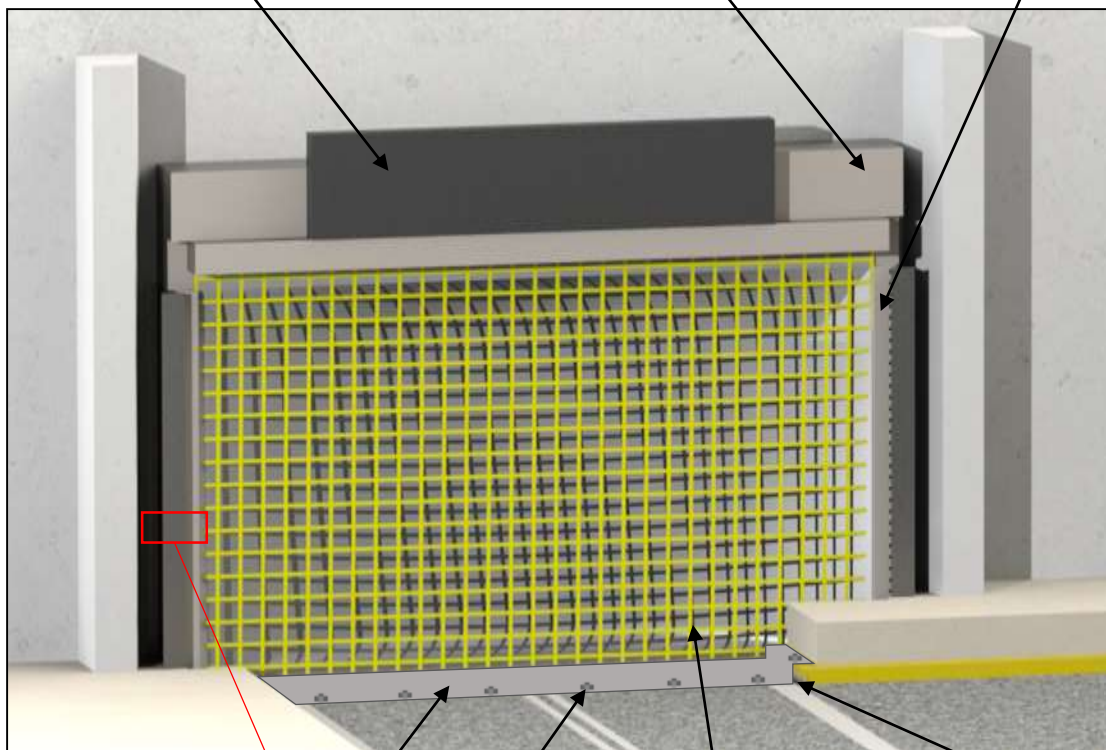
Design studies complete/in-progress for NYCT rail yard systems, Holland Tunnel, HCT/QMT, DOT Tunnels. Also, commercial & municipal properties (garages, WTC VSC).



Portal Flex-Gate®

Sign Storage Container Gate Guide

Spool



Deadman

Skirt

Preset Anchors

Debris Impact
Protection Net

Drain Plugs

Skirt not shown

Structural
Restraint Layer



Bladder Layer

General system attributes

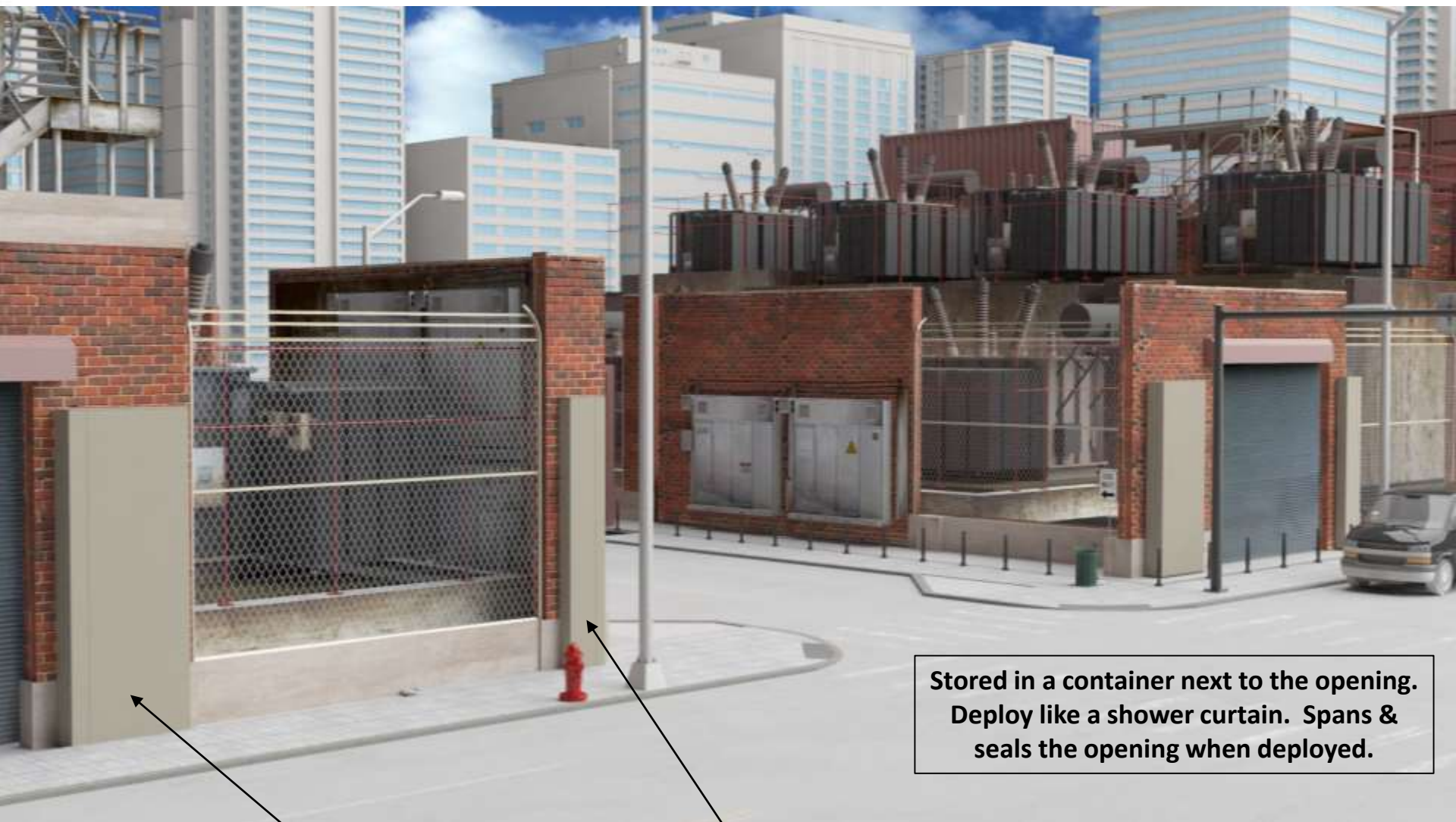
- Point of use storage
- Low maintenance (few moving parts)
- Self-contained system
- Simple operation
- Deploy in <5 min by 2 people (20ft)
- 75 yr life (membrane replacement at 25 yrs)
- Withstand up to 14ft water head
- <0.5gal/min/ft perimeter seepage
- Stainless Steel / Kevlar / Coated Fabric
- Certified to NY MTA DG312
- Scalable design
- Can be operated in high winds
- Resists environmental & chemical exposure



Installed 58 openings at NYC power company. Studies complete / waiting procurement on NYCT locations (207th rail yard, BBT/QMT, buildings, WTC VSC & memorial, etc.). Also waiting procurement on NYU Hospital and many US commercial properties.



Side Deployed Flex-Wall®

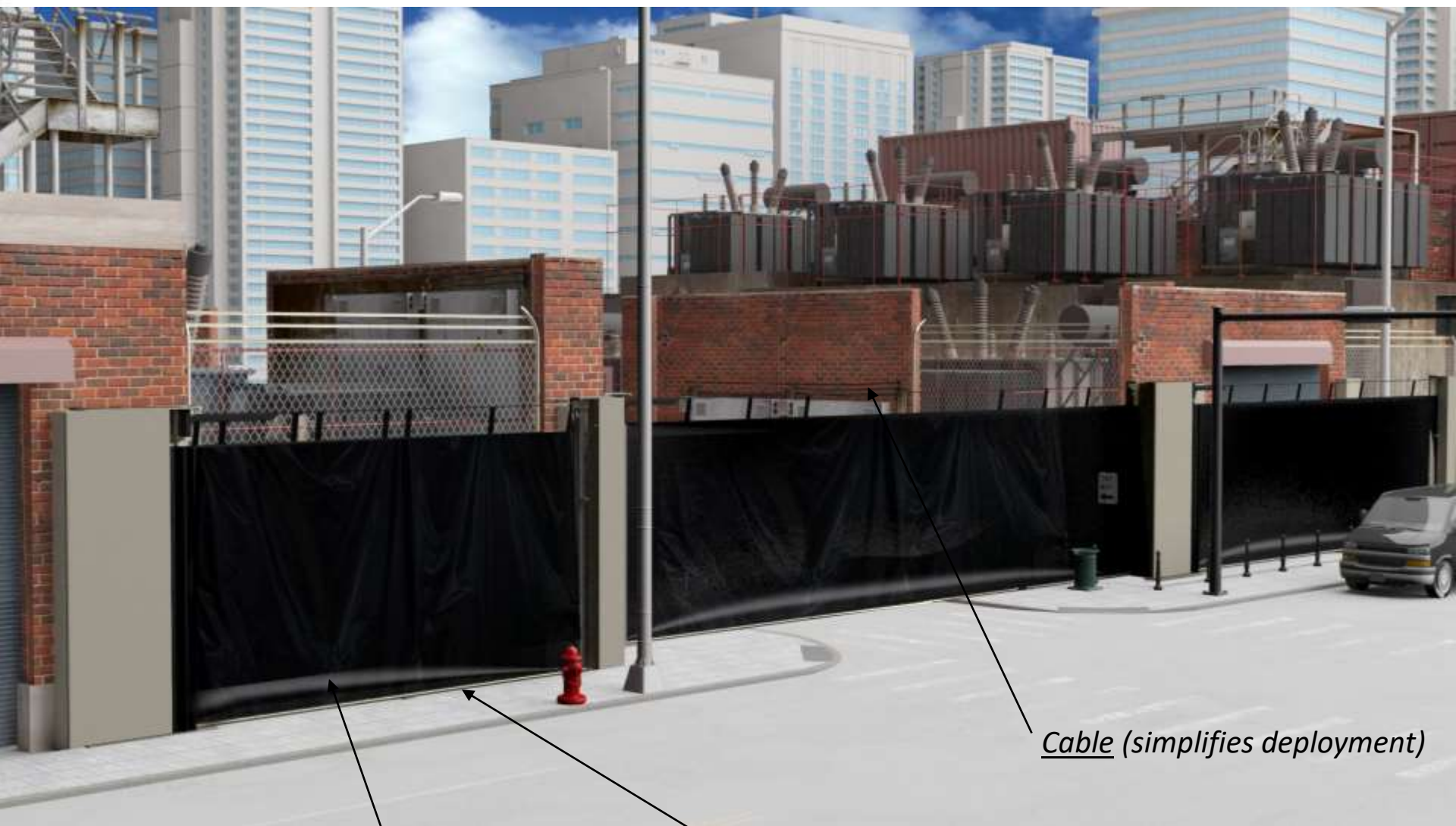


Container (houses the stowed flexible wall)

Receiver (what the flexible wall connects & seals to)



Side Deployed Flex-Wall®



Flexible Wall (water impermeable barrier)

Skirt (seals to ground - clamped version shown)

Cable (simplifies deployment)



Side Deployed Flex-Wall®



Many configuration options are possible



Side Deployed Flex-Wall®

Open Storage Container



Open Receiver Cover



Connect Cable & Deploy Wall



Release Skirt



Clamp Receiver

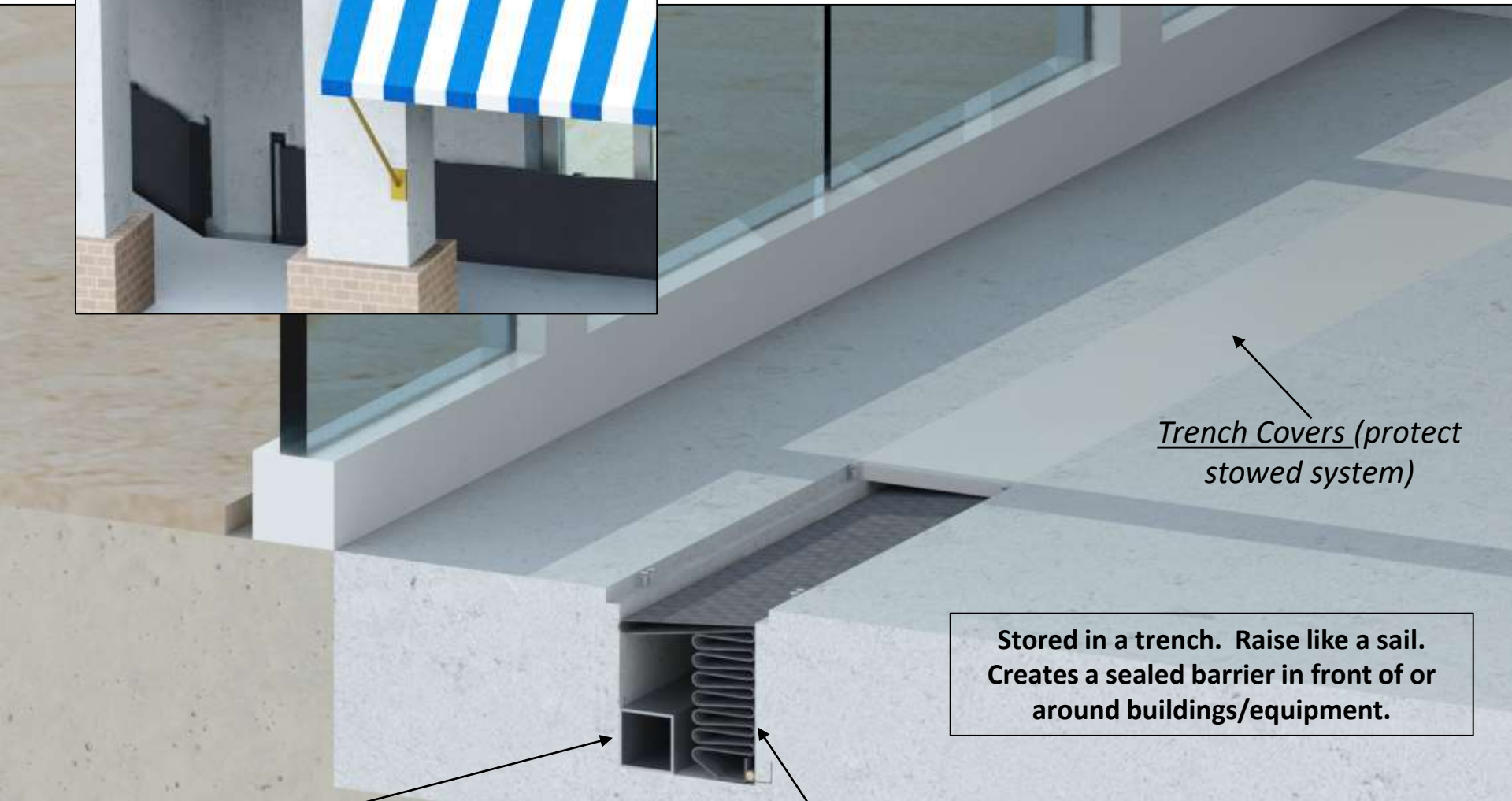


Position Skirt





Vertically Deployed Flex-Wall®



Trench Covers (protect
stowed system)

Stored in a trench. Raise like a sail.
Creates a sealed barrier in front of or
around buildings/equipment.

Posts (support flexible wall)

Flexible Wall (water impermeable barrier)



Vertically Deployed Flex-Wall®

Packed in Trench



Mount Posts



Remove Covers

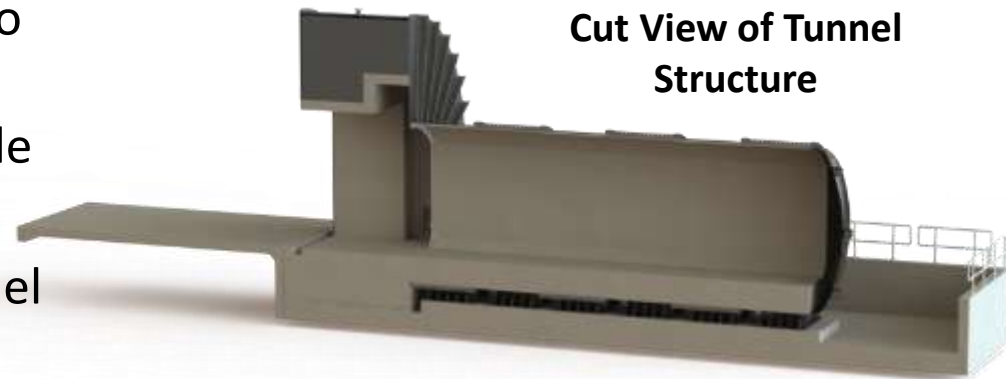


Raise Flexible Wall



ILC Test Site

- ILC has invested in a test facility to validate, demonstrate, and train potential customers on deployable flood barriers
- Full scale portal and subway tunnel designed to match install profiles
- Additional test capabilities added for full scale side deploy wall testing



Subway Tunnel Profile

Portal Flex-Gate™ Testing

Horizontal Flex-Gate™ Testing

Flex-Wall™ Testing

Basin

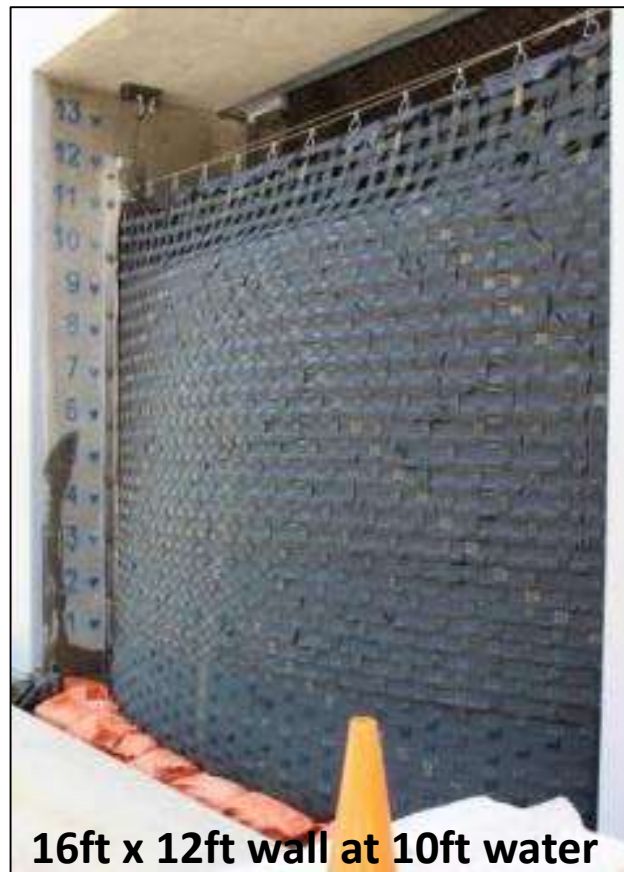




Side Deployed Flex-Wall™



20ft x 8ft wall at 6ft water



16ft x 12ft wall at 10ft water

Factory Acceptance Testing

- Wall is intentionally contoured
- Scalable test facilities
- Measure performance attributes
- 3rd party witnessing
- Impact attenuation (100lb log @ 5fps)
- Weighted skirt seepage <0.42 GPM/LF of seal
- Clamped skirt seepage <0.09 GPM/LF of seal (commercial goal is 0.08 GHP/LF of seal)

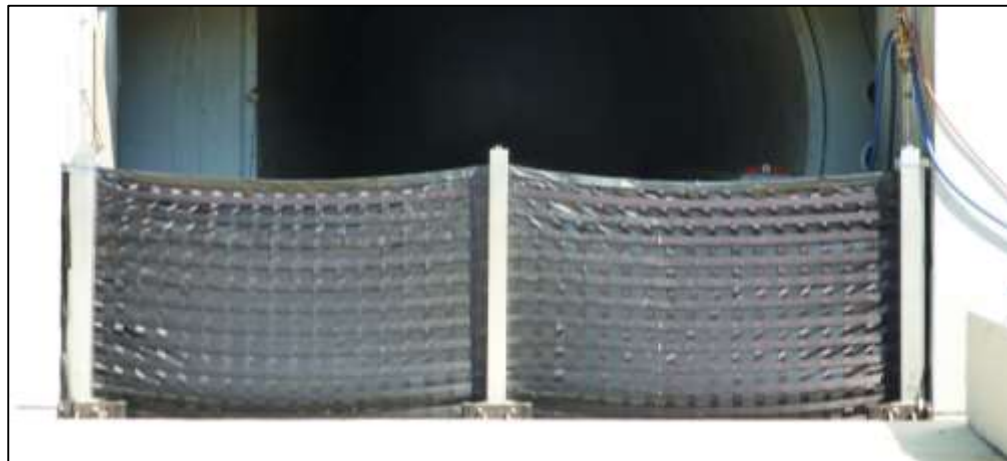


Vertically Deployed Flex-Wall™



Deployment testing at ILC

30 April 2017



Log impact testing at ILC

ILC Dover



Testing Flex-Gate™



- 6.9 psi proof test (~16ft water or 1.25x operational pressure)
- Leakage at operational pressure was below the requirement

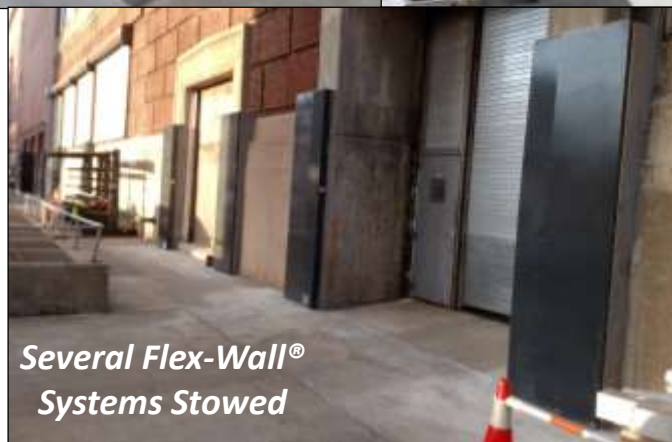
Item	Quantity
Flex-Gate (Softgoods)	~ 70lbs.
Top Plate	7,500 lbs.
Water	~1500 gal. (12,500 lbs.)





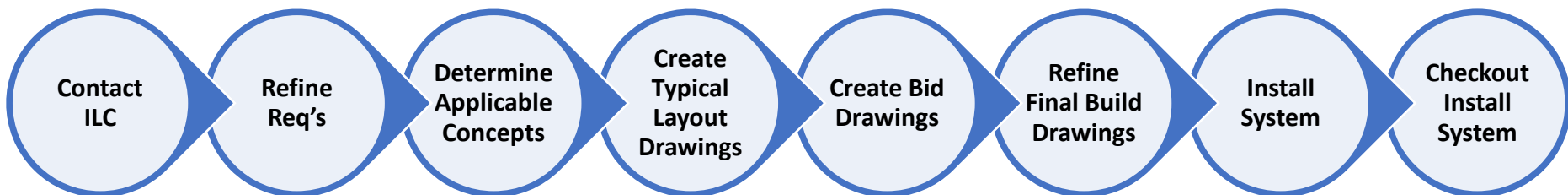
Implementation

- Flex-Gate® and Flex-Wall® systems have been installed and tested in several locations
- Currently, 23 stairwells Flex-Gate® systems have been installed for NYCT
 - First prototype system has been installed for several years and evaluated in the stowed configuration
- Several Flex-Wall® systems have been installed in multiple locations
 - Several types of systems have been installed and tested
 - Emergency egress – Alcove created in front of an opening
 - Span – Prevent water intrusion in an opening
 - Water Barrier – Non-structural system which water proofs a wall
- Education of structural requirements and flood loading



Summary

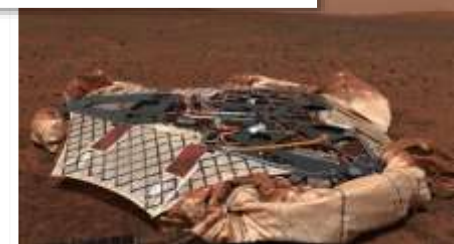
- ILC continues to work with customers to determine needs and update designs
- Softgoods technology offers many benefits that allow ILC to respond to customer needs
 - Low stowed volumes (**Fits in tight places**)
 - Conformal Materials (**Adaptable to any opening**)
 - Scalable (**Can size to fit location and loading**)
 - Low maintenance (**Minimal mechanisms**)
 - High reliability (**Simple designs based on proven technology in the harshest environments**)





Questions

- *ILC was founded in 1947 and has been developing products for flood protection since 2008*
- *ILC is a solution provider – we solve life-critical problems with our technology and experience*
- *We leverage our core technology from space suits / airships into industrial applications like flood protection*
- *We have developed a line of flexible flood protection solutions that are stored at the point of use*
- *These products are easy to use and offer low life-cycle cost to transit, municipal and commercial property clients*



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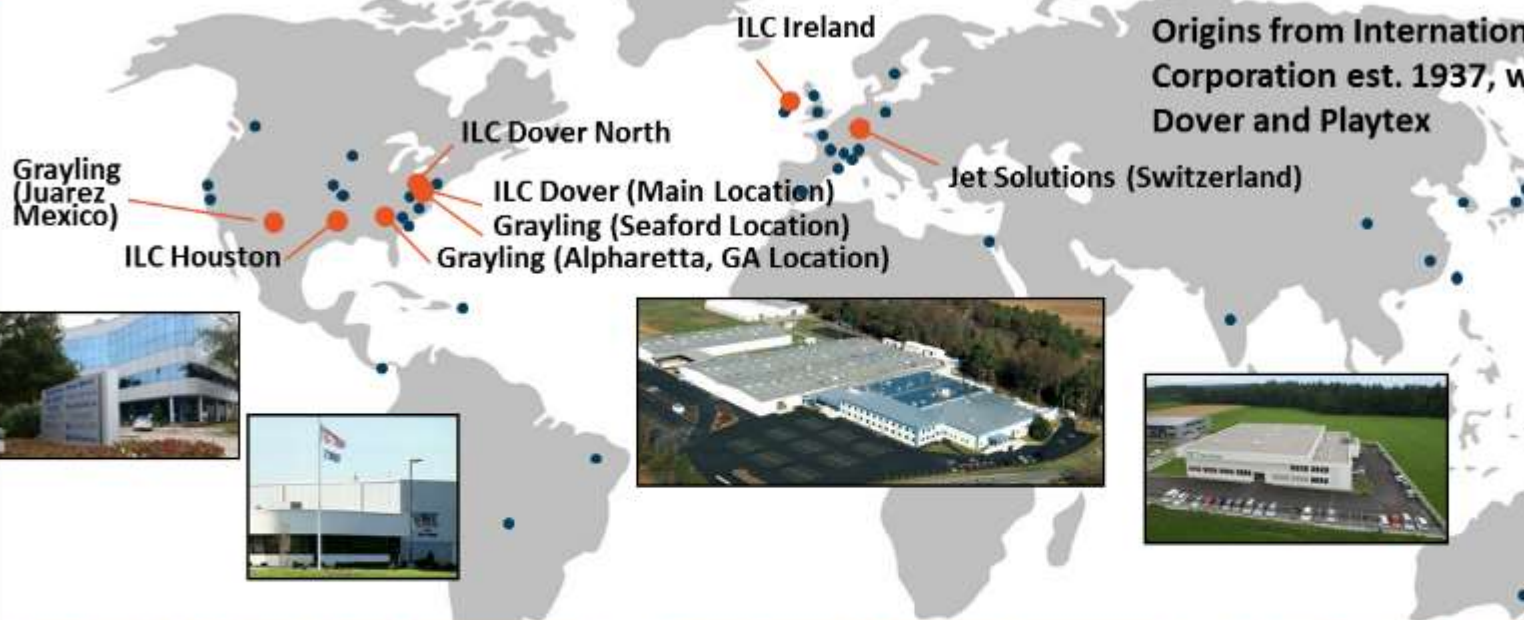
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creating what's next

Company Overview

● Facilities ● Sales Reps



ILC Dover est. 1947

Origins from International Latex Corporation est. 1937, which became ILC Dover and Playtex



650 Skilled Employees



Worldwide Sales Team

Quality Oriented Systems

- Registered to ISO 9001:2008
- NHB-5300.4 (1D-2)
- AS 9100 Registered



Extensive Facilities

>500,000 sq ft
(118,000 sq ft High Bay Production)

Development, Test Lab,
Fabrication and Production
Facilities



Core Competencies

Materials Development

- Structural containment for use in extreme environments
- Barrier films
- Coated /laminated materials

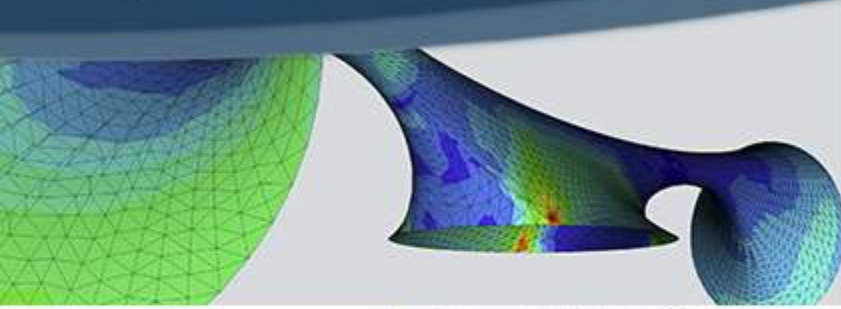
Engineering / Design

- Using softgoods to solve life critical problems
- Designing softgoods to replace traditional rigid elements
- Designing articulated softgood pressure vessels

Manufacturing

- Production, inspection and testing of inflated structures
- Precise, reliable sealing for critical applications

Capabilities Overview



1

**Collaboration to Address
Demanding Requirements**

2

**Computer Aided Design and
non-linear structural analysis**

3

**Advanced Materials Development –
customized to your application**

4

**Qualification and
Certification Testing**

5

**Process Controlled Fabrication –
heat sealing, sewing, and cementing**

6

In Field Support