DESIGN FOR RESILIENCE: EMBRACING THE CHALLENGE

Designing for Extremes: Building a Resilient City
Jon Penndorf, FAIA, LEED AP BD+C, RELi AP
Perkins+Will
PERKINS+WILL AT A GLANCE /

FOUNDED IN
1935

TOTAL STAFF
2200+

DISCIPLINES
6
- Architecture
- Interior Design
- Branded Environments
- Planning + Strategies
- Urban Design
- Landscape Architecture

PRACTICE AREAS
8
- Corporate + Commercial
- Science + Technology
- K-12 Education
- Higher Education
- Transportation
- Civic + Cultural
- Sports + Recreation

STUDIOS
26
- Arhus
- Atlanta
- Austin
- Boston
- Charlotte
- Chicago
- Copenhagen
- Dallas
- Denver
- Dubai
- Durham
- Hamilton
- Houston
- London
- Los Angeles
- Miami
- Minneapolis
- New York
- Ottawa
- San Francisco
- São Paulo
- Seattle
- Shanghai
- Toronto
- Vancouver
- Washington, DC
A government-backed rating system for healthier workplaces

Perkins+Will is the first company to pursue Fitwel certification for all of its North American offices.

Helping cities around the world become more resilient

Working for the Rockefeller Foundation, Perkins+Will will facilitate the resilience planning for Toronto, Ontario and Louisville, Kentucky.

A web-based tool for building teams to collaboratively assess and choose healthy products and materials

Perkins+Will, a founding partner of Portico, along with Google and HBN, is the first architecture and design firm in the world to offer the tool to its clients.
OUR COMMITMENT TO RESILIENCE
Three Questions to Ask for Every Project

1. What are the climate projections in your project location?

2. What are its vulnerabilities and cascading consequences as a result of those projections?

3. How does your design solution address those vulnerabilities?

PERKINS+WILL
OUR COMMITMENT TO RESILIENCE
Resilience Research Lab
VALUES OF RESILIENT DESIGN – THE TRIPLE BOTTOM LINE

Using three lenses to make the case:

Economic Benefits:
• What is the cost to bounce back?
• Insurance premiums
• Up-front costs for preparations
• Business continuity – what is the cost of stopping work?

Environmental Benefits:
• Mitigating certain climate events
• Less reparation after an event
• Reducing pollution and waste
• Energy independence

Social Benefits:
• Health and wellbeing of occupants and users
• Reduced anxiety and stress-induced issues
• Is there a greater benefit to the larger community?
UNDERSTANDING CHALLENGES
Acute Shocks

Quick impacts from extreme social, environmental, and economic events

Social /
- Civil Unrest
- Terrorism
- Infrastructure Failure
- Disease Outbreak
- Fuel Supply Disruption

Economic /
- Stock Market Crash
- War
- Cyber Attack
- Business Closure

Environmental /
- Extreme Rainfall
- Flood
- Fire
- Snow / Blizzard
- Hurricane/Earthquake
- Freezing
- Extreme Heat or Cold
**UNDERSTANDING CHALLENGES**

Chronic Stressors

**Lingering impacts from repeated exposure to social, environmental, and economic problems**

<table>
<thead>
<tr>
<th>Social /</th>
<th>Economic /</th>
<th>Environmental /</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Aging</td>
<td>• Debt</td>
<td>• Air Pollution</td>
</tr>
<tr>
<td>• Disability</td>
<td>• Poverty</td>
<td>• Coastal Erosion</td>
</tr>
<tr>
<td>• Disease</td>
<td>• Recession</td>
<td>• Deforestation</td>
</tr>
<tr>
<td>• Homelessness</td>
<td>• Unemployment</td>
<td>• Drought</td>
</tr>
<tr>
<td>• Low Education</td>
<td></td>
<td>• Species Engagement</td>
</tr>
<tr>
<td>• Language Barrier</td>
<td></td>
<td>• Water Scarcity</td>
</tr>
</tbody>
</table>

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TOOLS
Process

PROJECT DNA
- Identify the project purpose.
- Identify the greater purpose.
- Identify the design drivers for the project.

INFORMATION GATHERING
- Gather Data relating to environmental, social and economic issues relevant to the site.

IDENTIFY VULNERABILITIES
- Shocks and Stressors Workshop
- SEE Exercise

IDENTIFY PATTERNS
- Host a work shop with the Pattern RELi tool

ESTABLISH PROOF
- Analyze the level of impact of the effects identified in the SEE exercise.
- Analyze the efficiency of the proposed actions that address the vulnerabilities.
- Identify key stakeholders that will be engaged for each RELi credit.
- Identify funding sources
- Establish a Business Case

IMPLEMENT

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TOOLS
Shocks and Stressors Workshop

Sourced from Rockefeller Foundation NDRC Academies
## TOOLS
Shocks and Stressors Workshop

### S-E-E MATRIX (SOCIAL-ECONOMIC-ENVIRONMENTAL)

<table>
<thead>
<tr>
<th>RISKS /</th>
<th>SOCIAL /</th>
<th>ECONOMIC /</th>
<th>ENVIRO /</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient Influx</strong></td>
<td>- Patient/Family Impact</td>
<td>- Overtime/staff costs</td>
<td>- Parking strain</td>
</tr>
<tr>
<td></td>
<td>- Staff family - daycare, etc.</td>
<td>- Supplies in demand</td>
<td>- Increased trash generation</td>
</tr>
<tr>
<td></td>
<td>- Local Community well being</td>
<td>- Cancelled appointments</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Community disruption</td>
<td>- Insurance collections</td>
<td></td>
</tr>
<tr>
<td><strong>Aging Campus Infrastructure</strong></td>
<td>- Reduced services</td>
<td>- Efficiency</td>
<td>- Potential water contamination</td>
</tr>
<tr>
<td></td>
<td>- Community disruption</td>
<td>- Capital cost of replacement</td>
<td>- Pollution</td>
</tr>
<tr>
<td><strong>Severe Storm</strong></td>
<td>- Capacity of the morgue</td>
<td>- Insurance premiums (with respect to building enclosure)</td>
<td>- Loss of heating or cooling</td>
</tr>
<tr>
<td></td>
<td>- Staff availability/disruption</td>
<td>- Utility costs</td>
<td>- Hazardous materials</td>
</tr>
<tr>
<td></td>
<td>- Patient influx (see above)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Community disruption</td>
<td></td>
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**PERKINS+WILL**
The RELi Resiliency Action List provides a comprehensive process for incorporating resilience into new building design and planning.

**Unique Areas**
- Hazards, extreme events, adaptation
- Strong ties to financing, regional economics
- Expanded social cohesion
- Expanded community + local self-reliance

**Comprehensive**
- Designed for scale-jumping
- City + Region → Campus + Site → Organization + Building
- Facilitates Correlated Risk + Co-benefits
Unique RELi Prerequisites / Credits Hazard Preparedness, Social Cohesion, Regional Economics

ANSI Integrative Process Standard (MTS Developed)
Integrative Living Design Planning Process (University of Minnesota)

Red Cross Ready Rating Program for disaster preparedness
U.S. Small Business Administration + Prepare My Business.Org

Fortified for Safer Business Standard V1.0
Urban Green Building Resiliency Task Force, June 2013 Proposals (NYC)
EPA Vulnerable Zone Indicator System + EnviroFacts
Nuclear Regulatory Commission / Academy Of Sciences

Envision Sustainable Infrastructure Rating System V2.0
Center for Active Design Sustainable Sites Rating System V2
LEED V4 and V2009 / NC, ND + Schools
Energy Star / 2030 Palette
(8) Categories:

- **PA** Panoramic Approach
- **HP** Hazard Preparedness (Readiness)
- **HA** Hazard Adaptation + Mitigation
- **CV** Community Vitality
- **PH** Productivity, Health + Diversity
- **EW** Energy + Water
- **MA** Materials + Artifacts
- **AC** Applied Creativity
RELi
Resiliency Action Kit

ACTION LIST
Summary / 60+ Actions

PROJECT TALLY
Tracking / Excel Spreadsheet

CREDIT CATALOG / On-Line Reference Brief
Comprehensive / 200+ Actions and How-To-Use

3 PART KIT
C3livingdesign.org/RELi

PERKINS+WILL
RELI 2.0
U.S. Green Building Council

- Formally released January 2019
- Consensus-based approvals
- Designed for use in tandem with LEED certification

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<table>
<thead>
<tr>
<th>CERTIFICATION LEVEL</th>
<th>POINTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RELi Certified</td>
<td>300-349 points earned</td>
</tr>
<tr>
<td>RELi Silver</td>
<td>350-449 points earned</td>
</tr>
<tr>
<td>RELi Gold</td>
<td>450-599 points earned</td>
</tr>
<tr>
<td>RELi Platinum</td>
<td>600-800 points earned</td>
</tr>
</tbody>
</table>
First things first: what are the risks?

- Shocks vs. Stressors
- What are we designing for?
- What are the unique challenges of the site?

Define the Problem.
Site Assessment

- What is the chance a site will flood within the lease term?
- Is the site near public transportation?
- Is it located near basic human needs?
THE REAL ESTATE SEARCH: GETTING REAL

Building Assessment
- Is there an option for passive survivability?
- Where are the air intakes?
- What is the energy source?

Shelter-in-Place
- Designate safe haven areas within a building
- Meeting areas away from windows
- Areas near necessities
- Sized to accommodate occupant load
Roof Access

- As area of refuge
- As convening location
- For stress relief
- Food cultivation
- Energy production
DESIGN INFLUENCING OPERATIONS

Provide:

• Area of refuge
• Area for convening
• Egress paths
• Shelter-in-place space for staff
• Roof access
• Easily-located emergency and first aid supplies
How does the design address:

• Air supply?
• Food supply?
• Potable water?
• Communications needs?
• What about waste?
RESILIENCE IN PRACTICE

VIACOM
CROSSROADS OF THE WORLD
1 ECONOMIC
2 ENVIRONMENTAL
3 SOCIAL
ECONOMIC

ENVIRONMENTAL

SOCIAL

• Site selection
• Business Community Participation
• Support Local Businesses
Site Selection

Economic Revitalization
Community Improvement

Increase in Tourism - Increased Visibility
Times Square Alliance / BID
Desirable Workplace
• Extreme Weather Conditions
• Climate Change
• Sustainable Practices
Disaster Preparedness
Location Considerations
Temperature Change

- Demand Response - Lowering light levels at extreme heat / high power usage
- Back up generators and sites – Loss of power
Sustainable Practices

• LEED Gold building
• LEED-CI certified office spaces – 13 floors to date
• Daylighting & views to exterior
• No onsite parking
• Multiple transportation options – bike storage, proximity to bus/train
Roof Access

- Reduce Rainwater Runoff
- Food Grown on site
- Area of refuge
• Extreme Situation Preparedness
• Diversity and Wellness Programs
• Community Participation
EXTREME SITUATION PREPAREDNESS

- Go Bag
- Emergency Protocols
- On-Site Food & Provisions
GLOBAL INCLUSION PROGRAM

• Diversity Support Programs
• Diversity Initiatives
RESILIENCE IN PRACTICE

CHRISTUS SPOHN SHORLINE HOSPITAL
Corpus CHRISTI, TEXAS
CHRISTUS SPOHN SHORLINE HOSPITAL | CORPUS CHRISTI, TEXAS

- 426,081 SF New Construction at Shoreline Campus
- 128,101 SF Renovation at Shoreline Campus
- New Level II Trauma Center with 38 exam rooms, 4 trauma/resuscitation rooms, and 10 fast track bays
- 191 Existing Beds; 196 New Beds
- 43,000 SF New Clinic at the Memorial Campus
- New 10 Story Patient Tower
- New Central Utility Plant
- Consolidated Regional Materials Management
CHRISTUS SPOHN | PROJECT GOALS

Goals established at resiliency charrette June 2015:
1. Resilient Construction
2. Design for Wind and Hurricane Effects
3. Elevating Critical Functions
4. Regional Response | Community Connection
5. Civil Unrest Mitigation
6. Provide a Command Center
7. Industrial Disaster Response
8. Epidemic Response
REGIONAL RISKS

Highest Risk:
1. Dallas-Plano-Irving, Tex.
2. Jonesboro, Ark.
3. Corpus Christi, Tex.
7. Austin, Tex.

http://www.bestplaces.net/docs/studies/safest_places_from_natural_disasters.aspx
CORPUS CHRISTI, TEXAS
RELI / SCORECARD

RELI PROJECT TALLY
For Communities, Buildings, Homes + Infrastructure

RELI ACTION LIST
Pilot V1.1
December 2015

PERKINS+WILL

135 4 228

TALLY
CLiving Design - Capital Markets Partnership - UMN Arch 8551 - AREA Research
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**Design Response / Hurricane + Tropical Storm**

- **Remains operable in a Category 3 Hurricane:**
  - Hurricane Category 4: Administration decides to shelter or evacuate
  - Hurricane Category 5: Complete Evacuation
    - RELi Hazard Preparedness: Req 1, c1

- Back up generator provided for **4 days**
  - RELi Hazard Preparedness: Req 2

- **4 days** of food & water for sudden emergency events and an additional **5 days** supply for planned events

- Emergency water supply of **12 gallons** per patient bed provided in on-site storage

- Redundant water, natural gas, electric and sewer connections to the local utility grid

- Thermal safe zone provided on 3 floors
**DESIGN RESPONSE / SEA LEVEL RISE + STORM SURGE**

- Above the 500 year flood plain – *(39' above sea level)*
- Utilizes Site Elevation High Point for Critical Functions
  - RELi Hazard Adaptation + Mitigation: Req1

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**Sea-level Rise and Flood Elevation**

A one-foot rise in flood elevation due to both sea-level rise and hurricane intensification leads to an inundation of 5,000-15,000 feet

**Impacts of Global Warming on Hurricane-Related Flooding in Corpus Christi:**

- Sea-level projected to rise by **2.6' by 2080**
- By 2030, structural damage to buildings affected by flooding due to major hurricanes is projected to rise by 60-100%

DESIGN RESPONSE / EXTREME RAIN

• Designed for extreme rain and storm surge with 2 story central plant
• Increase permeable surfaces on site
• Oversized roof drains to large underground storage tanks which slowly release water back into ground
  – RELi Hazard Adaptation + Mitigation c2.1-2.4/2.7

24 inches of water fell in the first 24 hours that Hurricane Harvey made landfall

Corpus Christi receives an average of 31.8 inches of rain per year
Design Response / High Wind + Tornado

- Impact Resistant Exterior Skin
  - Large missile impact glazing on all levels
- Sheltered Core areas where patients can be moved away from exterior windows during high wind events
  - Not constructed to “Storm Bunker” standards
- Building exterior and interior elements designed to withstand 160 mph for exposure of category D (local code minimum is 120 mph)
  - RELi: Panoramic Approach c3

Hurricane Harvey made landfall with wind speeds as high as 134 mph.

In addition, 19 tornadoes were also reported during August 25th and 26th.
DESIGN RESPONSE / COMMUNITY COHESION + SOCIAL VITALITY

• Broad community alignment – CHRISTUS Spohn’s disaster response plan encourages the community to seek out service during disasters
  – An emergency command center is located in the Physician’s Lounge
  – RELi: Community Vitality Req1

• Participates in local and regional recovery programs and will be the command center and refuge for the community
  – 2 large community meeting rooms on the ground floor which can double as emergency shelter during a disaster
  – RELi: Community Vitality c4.2-4.4
DESIGN RESPONSE / INDUSTRIAL DISASTER

- Level II Trauma Center located on the ground floor
- Entire ambulance bay and court can be readily converted to an outdoor disaster center
- Administrative offices can be converted to inpatient beds during mass-casualty emergency events
- Observation unit adjacent to the emergency department can provide overflow capacity
  - RELi Applied Creativity: Mass Casualty & Chemical Spills Preparedness
Design Response / Epidemic Response

- Emergency Department air is isolated from the remainder of the Hospital's air distribution system.
- The Observation Suite is designed to be converted into a fully exhausted containment suite for mass epidemic events.
- There is always a 4 day supply of food and water on hand in the event of a lockdown or isolating event (Civil Unrest/Epidemic Response).
- Dedicated material lift from the emergency department to the pharmacy.
- Numerous on-call rooms to provide overnight/emergency staff accommodations.
  - RELi Applied Creativity: Bio Terrorism, Epidemic Outbreak