Resilient By Design

Post-Sandy Design Guidelines and Practice at PANYNJ

Josh DeFlorio, Chief, Resilience & Sustainability
November 2017

Our Facilities

Port Authority District Map

Aviation
- John F. Kennedy International Airport
- LaGuardia Airport
- Newark Liberty International Airport
- Stewart International Airport
- Teterboro Airport
- Atlantic City International Airport

Bridges
- Bayonne Bridge
- George Washington Bridge
- Goethals Bridge
- Outerbridge Crossing

Bus Terminals
- Port Authority Bus Terminal
- George Washington Bridge Bus Terminal
- Journal Square Transportation Center

Port Commerce
- Port Jersey-Port Authority Marine Terminal
- Brooklyn-Port Authority Marine Terminal
- Elizabeth-Port Authority Marine Terminal
- Howland Hook Marine Terminal
- Port Newark

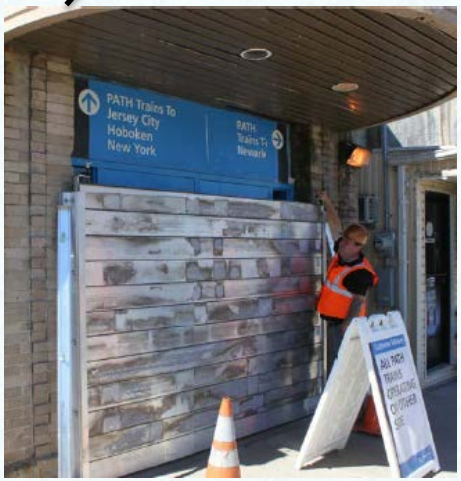
Tunnels
- Holland Tunnel
- Lincoln Tunnel

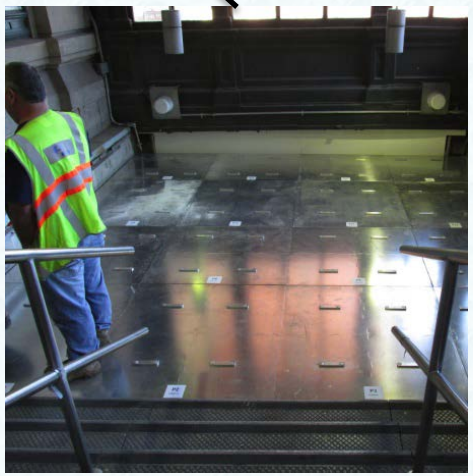
Rail
- Journal Square Transportation Center
- PATH Rail Transit System

World Trade Center

Post-Sandy Priority Protective Measures (PPMs)

Example: PATH





Designing for a Resilient Future

Port Authority Environmental Sustainability Policy (2008)

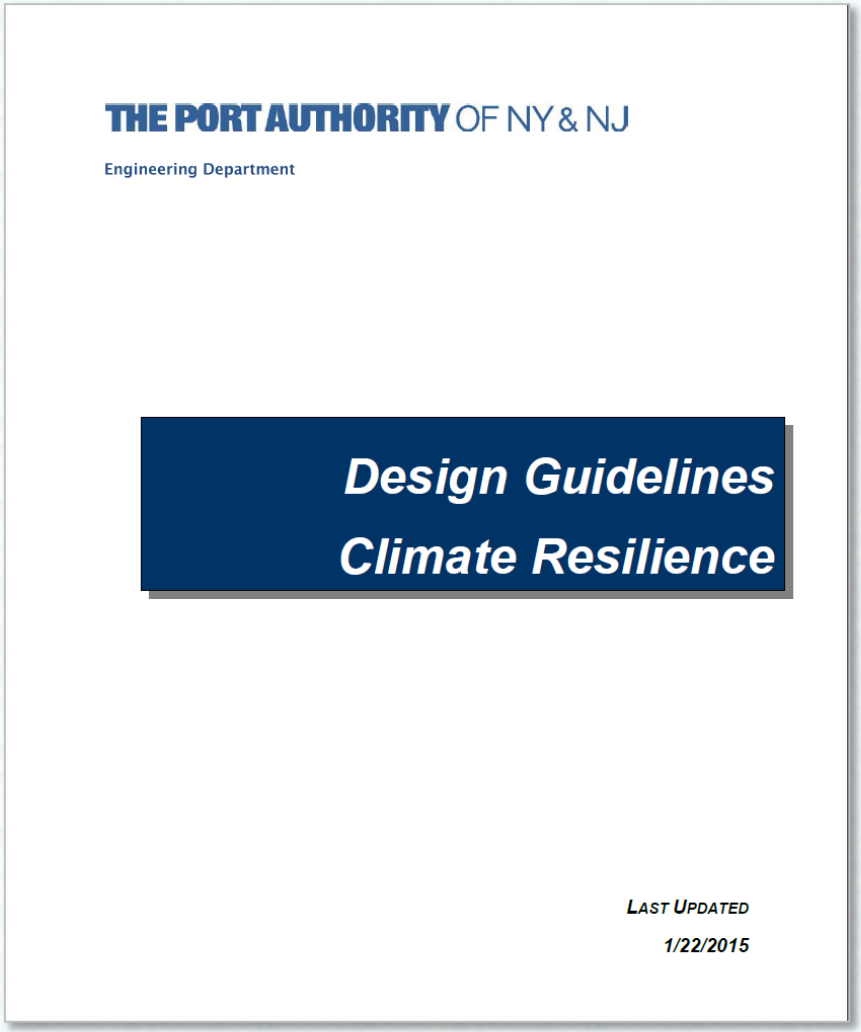
"The Port Authority will develop strategies that ***reduce the risk posed by climate change to its facilities and operations*** *and, in* ***collaboration with other regional stakeholders, develop strategies that mitigate the risk to the region*** *posed by climate change in a manner that will* ***promote a sustainable environment****."*

[emphasis added]

Designing for a Resilient Future

PANYNJ Climate Resilience Guidelines

- A “code plus” approach to developing criteria for resilient design
- Encourages creative, cost-effective design solutions
- Considered for all relevant PA capital projects
- Addresses coastal inundation hazards
- Issued in 2015 (supersedes 2009 standard)



Designing for Flood Protection
Standards/Codes

Meet or exceed minimum applicable codes and standards, including:

- **ASCE 24 Standard – *Flood Resistant Design and Construction***
- **ASCE 7 Standard – *Minimum Design Loads for Buildings and Other Structures***

Flood Protection Design Criteria

Sea Level Rise and Severe Storms

- **Establish flood protection level (elevation and loads) <u>above code</u> based on:**
  1. **FEMA BFE**
  2. **Freeboard (Code/ASCE 24)**
  3. **Sea Level Rise**

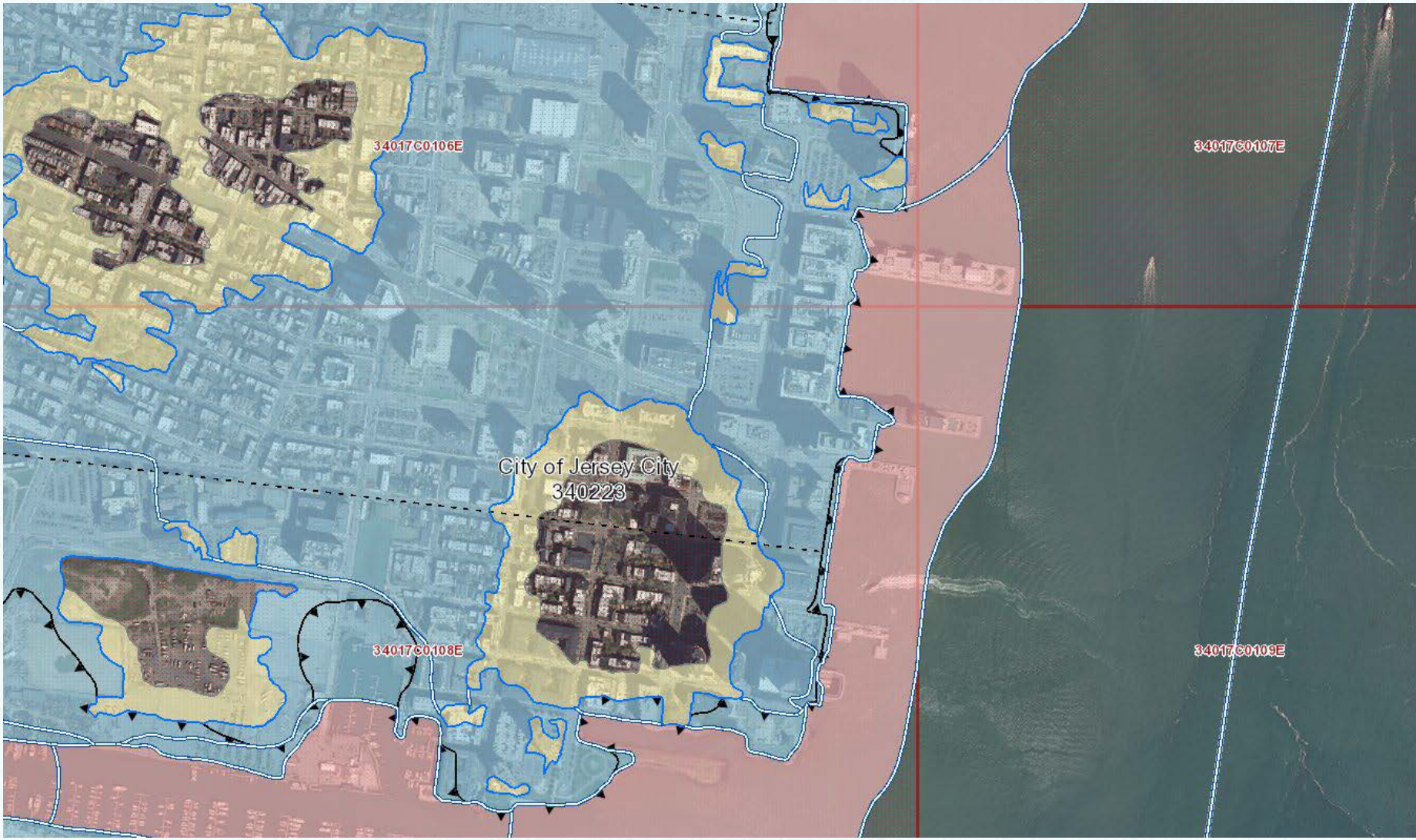
CODE

CODE +

- **Recognize system-wide flood protections already in place**
- **Perform Benefit Cost Analysis for high value projects**

FEMA Base Flood Elevation

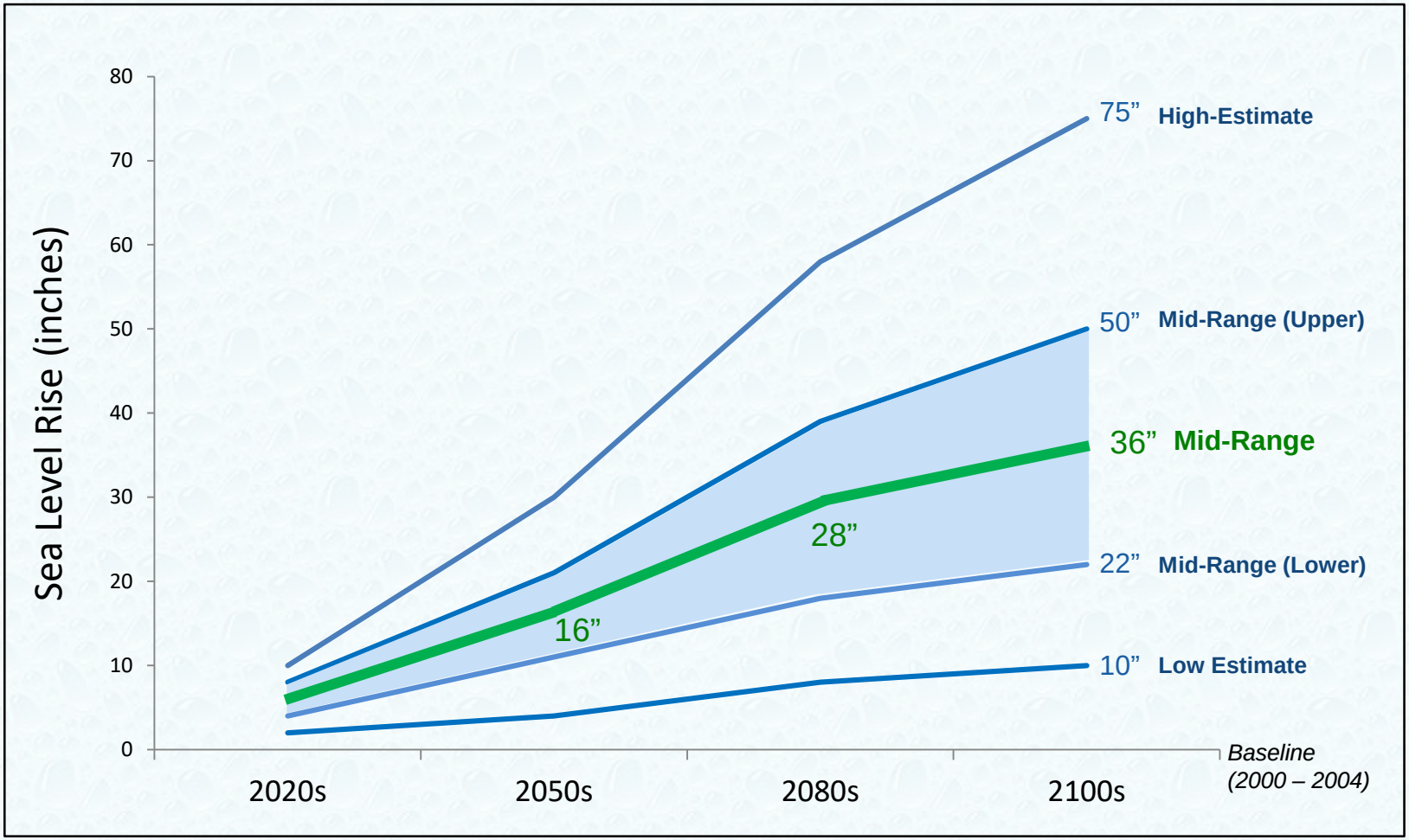
1% Annual Exceedance Probability ("100-year") Event



Freeboard
Asset Criticality

- **NYC/NJ flood hazard code defines critical/non-critical buildings**
  - **Code flood protection levels higher for buildings deemed "critical"**
- **Additional PA Critical Assets:**
  - **Train Tunnels**
  - **Vehicular Tunnels**
  - **Electrical substations/switch houses and emergency generators**
  - **Fire Protection Systems**
  - **Aircraft Fueling Systems**
  - **Pumping Systems and Dikes**

Regional Mean Sea Level Rise
New York City Panel on Climate Change



Source: NASA Goddard Institute, Columbia University (2013)

Applicable to Port District and Recommended for Port Authority adoption by Office of Environmental and Energy Programs

PATH

EXAMPLE: Head House Protection

Design Flood Elevation

- FEMA BFE 12.0 ft. + } CODE
- Freeboard 2.0 ft. + } CODE
- SLR Adjustment 3.0 ft. = } CODE +

17 ft. NAVD88*

* Approx. 9.9 ft. above grade

Design Solutions

- Construct flood wall (water side)
- Construct flood wall at escalator and install side-coiling fabric barrier at turnstiles
- Install flood-rated exit doors at sides
- Reinforce concrete vent shaft and stair shaft walls

Status: Stage III/IV (Final Design)

Project particulars are subject to change

PATH

EXAMPLE: Elevator Flood Resiliency

Design Flood Elevation

- **FEMA BFE** **12.0 ft. +** } CODE
- **Freeboard** **2.0 ft. +** } CODE
- **SLR Adjustment** **3.0 ft. =** } CODE +

17 ft. NAVD88*

* Approx. 11.3 ft. above grade

Design Solutions

- **Replace existing stop log system**
- **Construct water-tight steel frame and glazing enclosure (aquarium glass)**
- **Protect entrance with stop logs or flood door**

Status: Stage III (Final Design)

Project particulars are subject to change

Ports

EXAMPLE: Electrical and Mechanical Equipment Resiliency

Design Flood Elevation

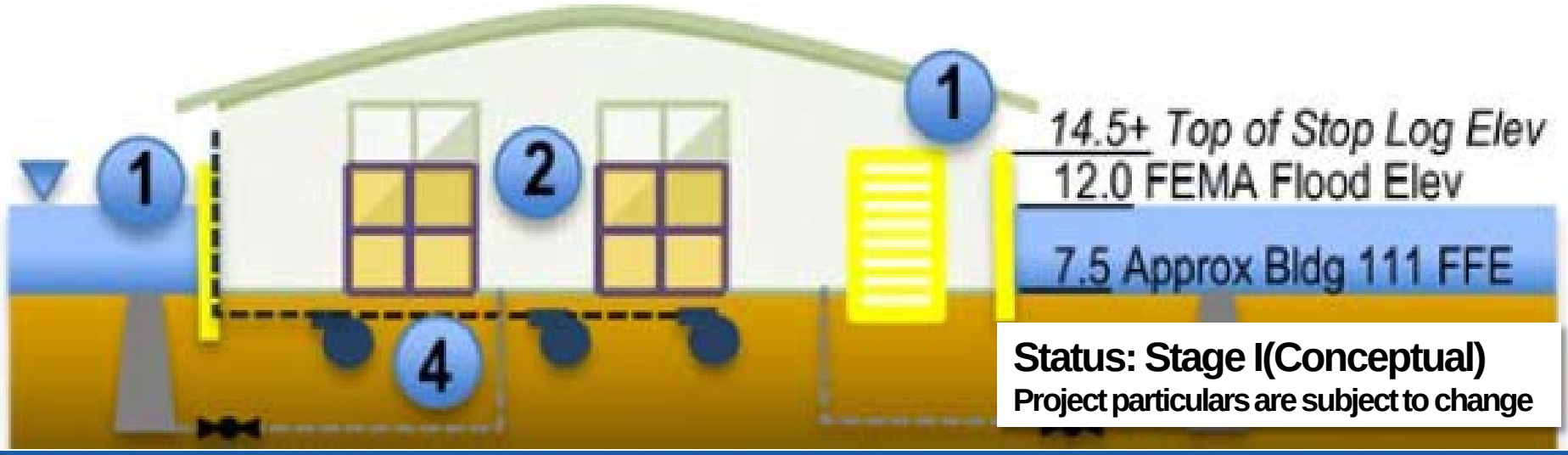
- FEMA BFE 12.0 ft. + } CODE
- Freeboard 2.0 ft. + } CODE
- SLR Adjustment 1.3 ft. = } CODE +

15.3 ft. NAVD88*

* Approx. 7.0 ft. above grade

Design Solutions

- Elevate generator, fuel tanks, and critical equipment
- Plug valve for sewer lines
- Sump pump systems for critical locations
- Submersible pumps
- Install stop log systems at access pts.



Status: Stage I(Conceptual)
Project particulars are subject to change

Aviation

EXAMPLE: Substation Flood Protection

Design Flood Elevation

- **FEMA BFE** **13.0 ft. +** } CODE
- **Freeboard** **2.0 ft. +** } CODE
- **SLR Adjustment** **2.3 ft. =** } CODE +

17.3 ft. NAVD88*

* Approx. **TBD** ft. above grade

Design Solutions

- **Elevate the entire structure OR**
- **Elevate internal critical equipment/ Wet floodproofing OR**
- **Dry floodproofing (permanent and/or deployable measures)**

Status: Stage I (Conceptual)

Project particulars are subject to change

What's Next?

Climate Resilience Guidelines 2.0

- **Evolve toward a multi-stressor approach**
- **Enhance coastal flooding approach**
- **Better integration of resilience and sustainability missions**
- **Incorporate resilience throughout project lifecycle**

Regional Collaboration

- **Regional transportation collaboration – working with MTA, NJ Transit, Amtrak, etc.**

- **Regional collaboration and technical exchange with NYC ORR, NYCEDC, NYCOEM, USACE, GOSR**

- **NYC Climate Change Adaptation Task Force**

Thank You

QUESTIONS?

Visit us at: www.panynj.gov

www.linkedin.com/company/port-authority-of-ny-&-nj

https://www.instagram.com/panynj

follow@panynj