

Pacific Coast Congress of Harbor Master & Port Managers



“Getting It Done”

- The Crescent City Harbor has a long history of damage and destruction from tsunamis.
- The city experienced tsunami conditions 31 times between 1933 and 2008
- In 1964, 12 people were killed and 19 blocks of the downtown area was destroyed.
- Today we'll discuss how the harbor recovered from the 2006 and 2011 tsunamis

Presenters:

- Ellen Johnck, Ellen Johnck Consulting
- Patrick Bailey, Crescent City Harbor District Board of Harbor Commissioners
- Charlie Helms, CEO/Harbormaster, Crescent City Harbor District
- Anita Yao, Wharfinger, Port of San Francisco

The 2006 Round of Destruction started on November 15

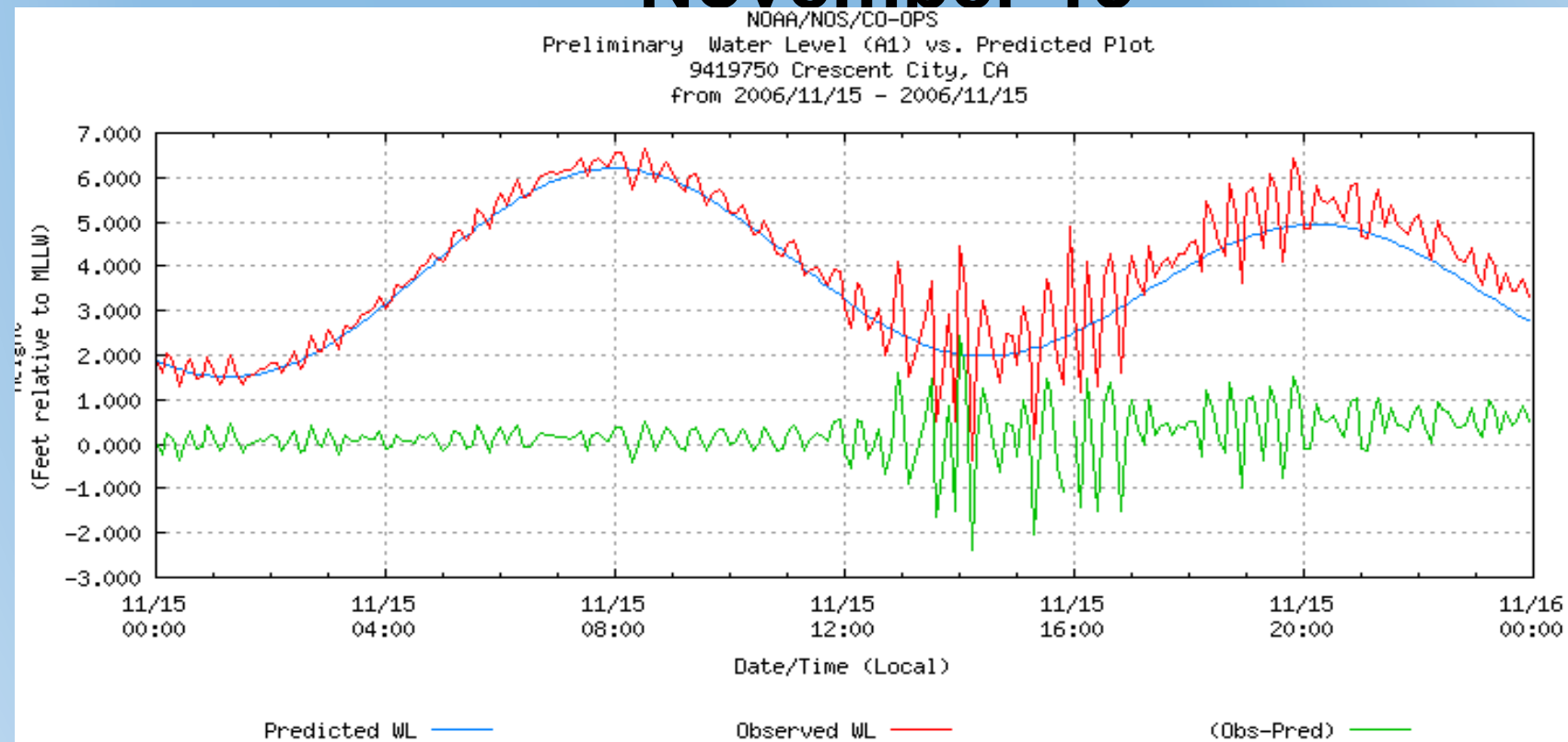




Image © 2006 DigitalGlobe

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Pointer 41° 44'51.96"N 124° 11'05.68"W elev 1 m Streaming ||||| 100% Eye alt 272 m

2006 Tsunami

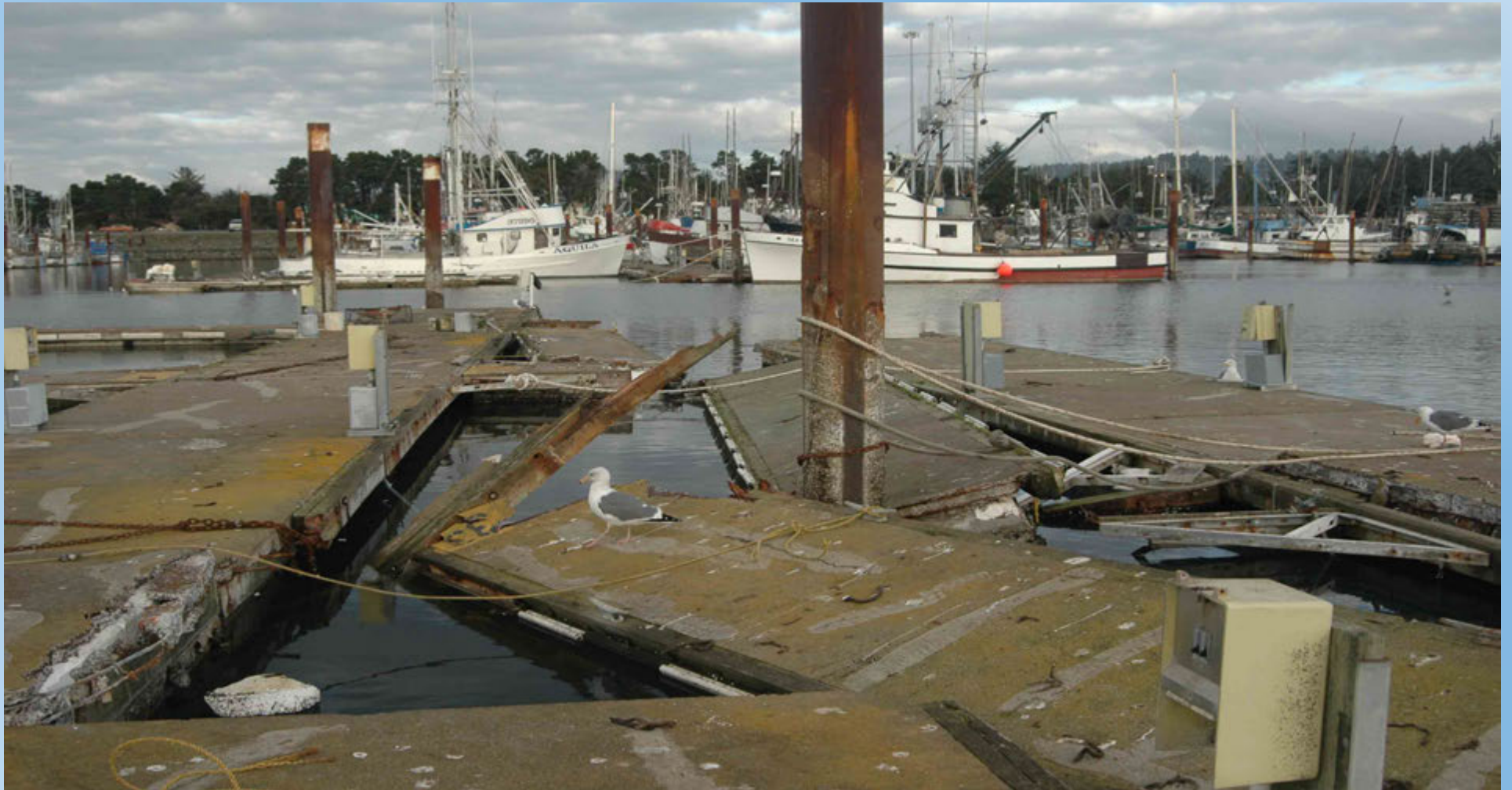
- The 2006 tsunami damaged the harbor but the true severity of the damages were discovered over a period of months
- The original damage estimate did not qualify the event for Federal Assistance
- The Harbor District had to find a way to raise \$5 million dollars to cover it's share of the rebuild
- CAL Office of Emergency Services did not want to upgrade the harbor – their goal was to put it back the way it was
- They would pay for a limited amount of hazard mitigation – up to 15% of project cost
- However CAL OES would pay for upgrades required by codes and standards



The question was “What are the Codes and Standards for Marina design in a tsunami zone?”

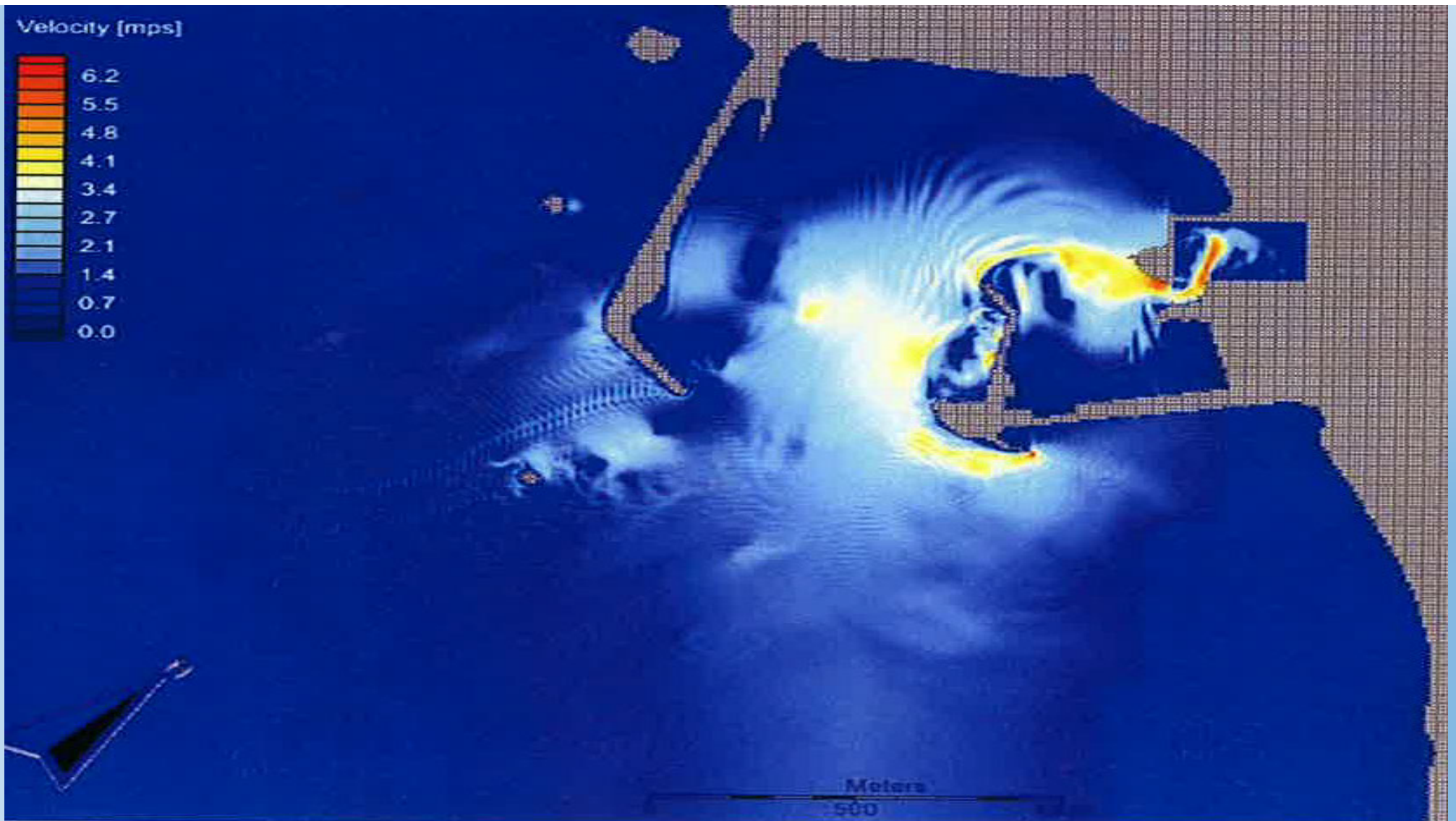
The answer: NONE!

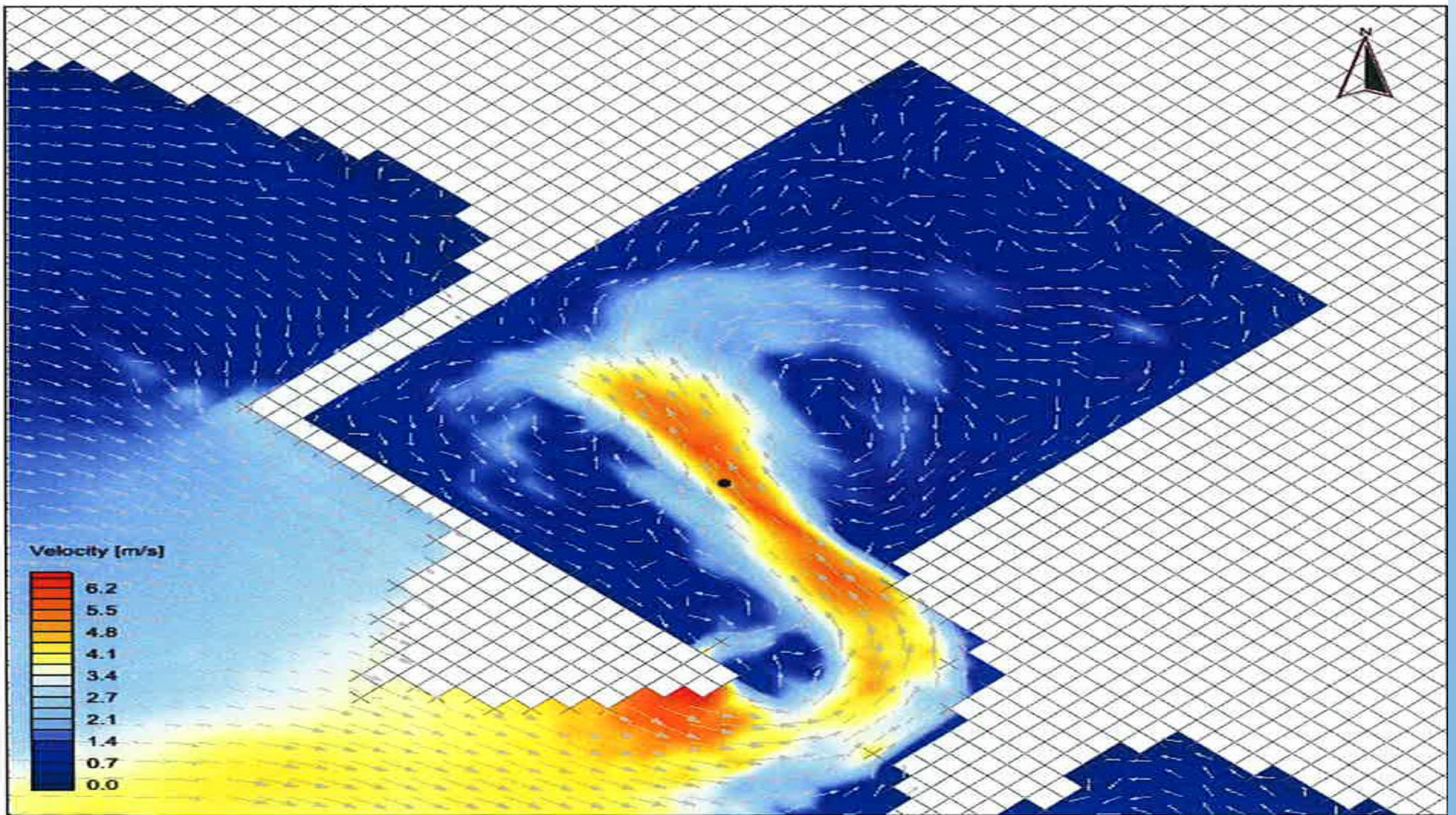
- There were no standards for tsunamis in 2006 but there were guidelines for Hurricanes
- The design return period on hurricanes should be balanced against the expected life of the marina, and compliance with local codes and ordinances. Keep in mind that codes are minimum design criteria and increased strength and reliability may be more economical in the long run
- The recommended design period for hurricanes (wind and tidal surge) is normally 50 years (2% probability, in any given year) and 25 years (4% probability in any given year) should be considered the absolute minimum design period. This is true even if the expected life of the offshore facilities is less than 25 years.

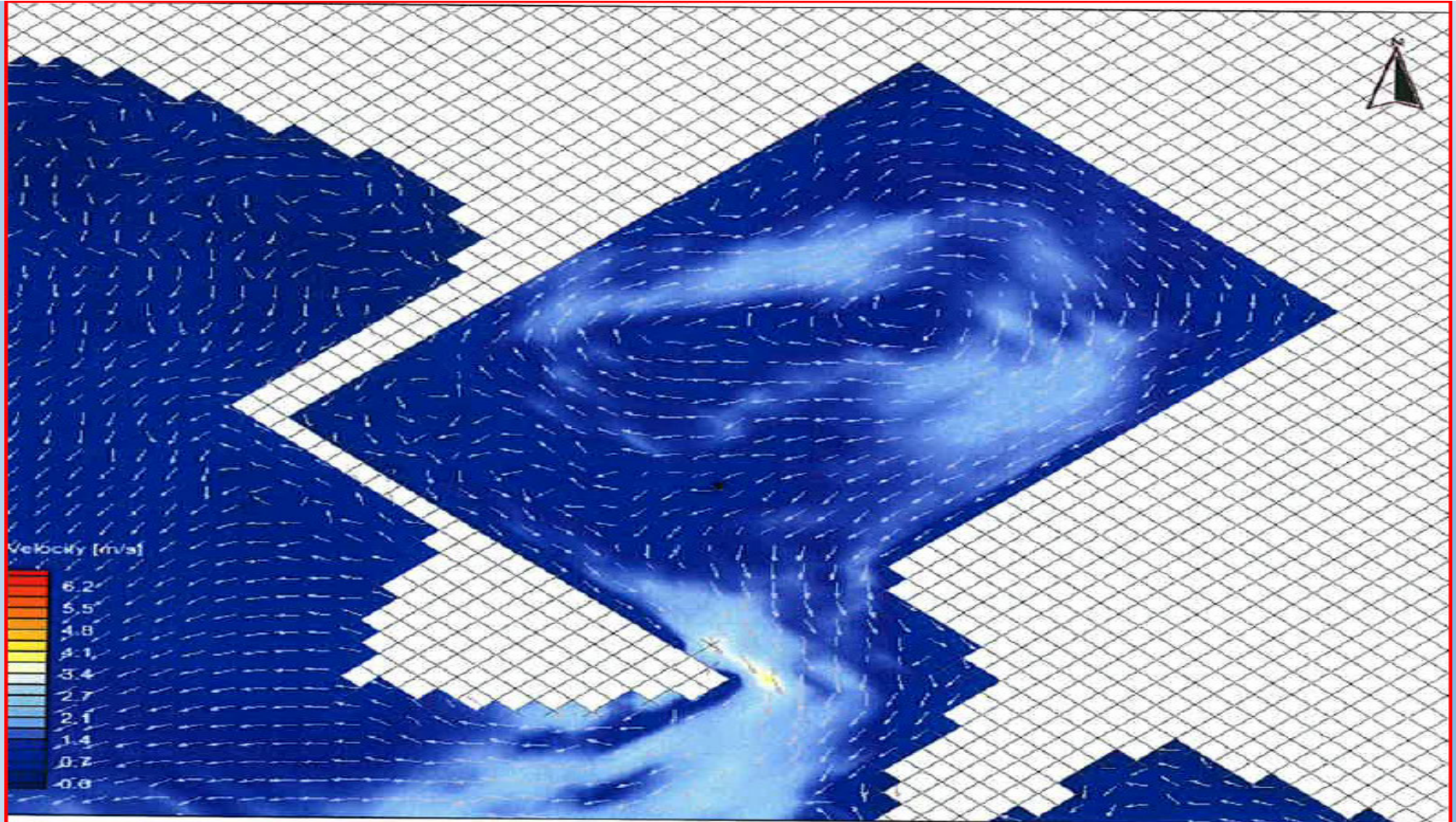


Ben C. Gerwick / COWI Tsunami Study

- The Harbor District, in an effort to support its assertion that the most efficient way to rebuild the harbor was to use the 50 year Hurricane standard, hired the Ben C. Gerwick engineering group, now a part of the COWI organization, to construct a predictive model for tsunami flow into the Crescent City Harbor
- The Harbor wanted evidence that it could use to convince the CAL Office of Emergency Services (CAL OES) that rebuilding the harbor to a fifty year return standard would actually be more cost efficient than just reconstructing the marina to its prior state







Ben C. Gerwick/COWI Study Results

- The previous slides show the predicted flow and velocity of a tsunami similar to the 2006 tsunami in the Crescent City Harbor
- Flows of over 6 meters per second (11.6 knots or 13.4 miles per hour) are predicted along the seawall at the mouth of the harbor
- The high velocity flow continues into the harbor itself and brings its full force onto “H” dock and continues to batter “G” and “F” with similar force
- The destructive then flows throughout the harbor in a generally clockwise flow at reduced velocities

Ben C. Gerwick/COWI Code Findings

- **British Code**(BS 6349-1:2000): “Normally a design working life of the order of 50 years is expected”
- **Australian Code** (as3962-2001): "Strength limit-state loads should be calculated for a 1 in a 50 year return period for wind, wave, surge and flooding loads“
- **EM** (1110-2-1615): "The economic design life of most small boat projects is 50 years"
- **European Code** (R46): For "port installations for (...) industrial operations (...) only 25 years [design service life] can be figured on"

2006 to 2011

- The Harbor District was able to secure a Community Development Block Grant (CDBG) for \$5 million which was used to cover the harbor's 25% cost obligation for its share of the 2006 tsunami repairs
- The grant was awarded to the Harbor so that the District could demonstrate the economic impact the fishing fleet and associated businesses had on the county
- In the meantime, the Harbor District through its District Engineer, Stover Engineering, filed for the permits needed to begin the harbor rebuild
- Stover Engineering managed the design and permitting process
- The permits pathway conformed to the CAL OES standard of rebuilding the harbor to its former condition

The Harbor's reconstruction permit was issued in late February 2011 – just a few weeks before the Harbor was completely destroyed



Stills taken from USCG video filmed during the tsunami event

The flow pattern of the 2011 tsunami was an amazing match to what was predicted in the Ben C. Gerwick/ COWI Study



Stills taken from USCG videos filmed during the tsunami event

Following the 2011 tsunami devastation, the California Coastal Commission put the rebuild debate to rest by mandating that a fifty year tsunami resistant harbor be constructed



To meet the fifty year standard, pilings were upgraded from 16 inch diameter to 31 inch diameter pilings which were driven into bedrock



The Bellingham Marine Unibolt concrete dock system was selected for the new harbor



After dredging operations were completed in the Inner Boat Basin, the Outer Boat Basin and the federal channel were dredged while the Inner Harbor was being reconstructed



Surge suppression dock at Harbor entrance

(Photo courtesy of Bellingham Marine)



View of Inner Boat Basin Piling Frequency

(Photo courtesy of Bellingham Marine)



View facing “H” Dock

(Photo courtesy of Bellingham Marine)



The West Coast's First Fifty Year Tsunami Resistant Harbor
The Crescent City Harbor District
(Photo courtesy of Bellingham Marine)

