Facility Design Considerations for Guam’s Challenging Environment

2010 NAVFAC Pacific/Hawaii Designer & Builder Symposium

Wednesday, 1 December, 2010
Hilton Hawaiian Village-Coral Ballroom
Guam Information Schedule:

1. **Guam Technical Guide Addenda to the UFGS – Design Bid Build** due in February 2011 and **Design Build** due in middle of March 2011

Addenda sections are a living document that includes unique Guam specification information to a specific and corresponding UFGS section. Designer of Record shall use the addenda section in conjunction with UFGS specification when preparing project specifications. Addenda sections cover specifications that are common to most projects and not unique sections such as elevators.

2. **Guam Navy Marine Architectural and Construction Standards** replaces current Marianas Region Architectural & Construction Standards (MRACS) and proposed **Common Components Study** due in May 2011

3. **USMC Guam Base Installation Appearance Plan** due in final due Dec 2010

4. **Comprehensive Study to Reduce Stand-Off Distances for New DOD Facilities** in Guam and the Commonwealth Northern Mariana Islands final due in Dec 2010
Assumption on this presentation is that the knowledge and solutions gained on military housing projects in Hawaii and Guam can be applied to larger military facilities in Guam’s challenging environment.
This Presentation

- The information in this presentation was derived from over 300 lessons learned and additional information over 15 years and 17 Navy and Marine housing projects both on Oahu and Guam by contractors and their personnel; CNIC HQ Housing Office, Navy and Marine housing offices; Marine and Navy families; private sector architectural and engineering firms; NAVFAC PAC and NAVFAC MAR architects, engineers, ACQ, planning, environmental, FEAD and ROICC offices in Hawaii and Guam, and energy management; consultants; new technology, PPV housing, material suppliers and manufactures, UH consultants and training including in hot humid climate design.

- The Partial Team List of Contributors:
  - Kaneohe USMC Housing Office Joe Park, David Buffum and their staff; Guam Naval Housing Office Roy Peredo, Nilda Dela Pena and their staff; Contractors and their subcontractors: Fletcher Pacific, Hunt Building Corporation, Watts Constructors, Black Construction Corporation, Core Tech International, Actus Lend Lease; Private sector A&E firms and their consultants: Design Partners Inc. Vernon Inoshita, Kendall Ellingwood & staff, Danilo D. Lopez Associates Dani Lopez, Rey Arquines & staff, Hawaii Pacific Engineers Frank Hino, Tony Lau & staff, Pacific Architects, Setiadi Architects LLC; NAVFAC PAC Housing Projects PDEs: Wayne Date, Dee Kimura, Kirby Hong, Shirley Matoi, Michael Wong, Ken Suyama, and John Weick; NAVFAC Program Managers Eddie Ige, Noren Kawakami, Merton Ishida, Gary Yamagata, Ken Nakasone, Casey Tavai, Stephanie Zampaga, Claudia Collins and John Weick; NAVFAC PAC CI 41 through CI 48 architects and engineers including also Herb Shinsato, Paul Nishizaki, Doug Kurth, Keith Mikami, Kristal Lizama, Mel Tsutahara, Evan Mizue, Eric Funasaki, Layne Hazama, Randy Yuen, Wah-Cheong SZE, Roman Gaoiron, Steve Yoneshige, Aaron Yasui, Karl Cheng, Brandt Takeuchi, Clint Hashiba, Owen Igarashi, Willy Takushi, Marian Wasko, Joseph Condlin, Carl Shimazu, Gary Yamagata, CI 5 Construction Division, O9SF safety Bernard Tom; NAVFAC PAC AM and Environmental; NAVFAC PAC ACQ Anne Saki Eli, Wanda Okemura, Dean Burnett, NAVFAC MAR CDR Keith Barton, Vincent Sablan, Andrew Sonier, Doris Castro, Raquan Hall, Roselle Guarin, Manuel Guarin, Bruce Hall, Edward Tapeceria, Ens Mathew Pine, Ens Michael Popovich, Mark Cruz, Troy Imamura, Kevin Evans; NAVFAC ESC Tom Tehada (corrosion) and Daniel Zarate (coatings), CNIC HQ. Housing Office Stephen Drumm, Hot Humid Climates consultant and training Dr. Joseph Lstiburek, Energy Star and LEED consultant Mitchell Johnson, UH Dr Julian Yates entomology (termites), UH Prof. Ian Robertson light gage steel framing & corrosion; to all the CONREPs and ETs on these projects including Godfrey Kaonohi, Walter McCracken, Carl Takayesu, Michael Kiyabu, Jerry Reining, Charles Noyes, Gerry Stothers, Danny Obrero, George Young, PPV & HSPE Brad Davis, Emily Mitchell, Kristal Lizama, Katie Howard, Sandy Ragley and to all that I have not listed I apologies and thank you to everyone.
PART 1

Guam Marine & Navy Military Design

Meeting Guam’s Challenging Hot Humid Climate and Other Challenging Issues

A. Super Typhoons
B. Earthquakes
C. Corrosion
D. Termites
E. Radon
A- Category 5 Super Typhoons of Sustained wind speeds of 250 km/h (156 mph) or greater.

Recent History:

- **December 2, 2002 Typhoon Pongsona**
  1300 homes destroyed $800 million in damages (areas of damage reduction were attributed to reinforced concrete construction & stronger building codes being adopted by Guam Government). 193 people were injured, one death due cuts from flying glass, 715 poles and 513 transformers were greatly damaged. (1 minute sustained wind gusts of 278 km/h (173 mph)

- **December 16, 1997 Typhoon Paka**
  1500 homes destroyed, 5000 people homeless, 10,000 buildings damaged, $645 million in damages. (1 minute sustained wind gusts of 295 km/h (185 mph)

- **August 28, 1992 Super Typhoon Omar**
  2,158 homes were destroyed with 3000 people homeless, $457 million in damages. (1 minute sustained wind gusts of 240 km/h (150 mph)

NOTE: Most current IBC and ASCE Codes are used to determine design for wind loading for Guam
Storm Damage History In general, concrete structures performed well during the typhoon. There were no concrete structural failures, noticeable concrete cracking, or lateral displacement movements as a result of the typhoon winds.

Typhoon damage to concrete structures was greatest where air conditioning units and appurtenances were blown off of roofs, windows and other openings were penetrated and where roofing failed.

Concrete masonry unit (CMU) buildings are porous and can absorb saltwater if not protected by a waterproofing membrane, sealant, or paint. If the protective layer is damaged due improper maintenance, to exposure or during storms and is not repaired, the CMU is prone to concrete spalling.

Avoid new metal buildings. If pre-engineered buildings are constructed, the structure and building skin to be rated for Guam’s typhoon winds and maintained under a regular maintenance, repair and inspection program due Guam’s marine corrosive environment.

Corrosion of metal framing and fasteners were a cause for both concrete and metal buildings being damaged or destroyed.
Concrete structure withstood high winds at NAVHOSP but rooftop AC, roofing, doors, and windows failed. This led to extensive interior water damage, moisture and mold problems.

**Note:** The report recommends all rooftop equipment be ground mounted and protected by walls.
In hurricane Andrews, 80% of the roof failures on homes were due to garage failures. This is also true for roll-up doors for other military facilities. This photo shows a reinforced CMU wall at the back of the garage creating protect wall for the military families living behind this wall. Interior protective CMU walls should also be used for facilities with roll-up doors. The walls are designed to meet Guam’s typhoon wind speeds. All garage single car doors and roll-up doors are designed to meet the typhoon wind speeds. Due to Guam’s typhoon winds, it is good design idea to reduce the width and size of these doors to a minimum to reduce wind exposure. Using multiple smaller doors with tie down columns in between these doors is prudent
B- Guam Earthquakes

- On August 8, 1993, an earthquake of a magnitude of 8.1 50 km (estimated) south of Guam. Structural damage loss was estimated at $4 million for homes, $113 million for private businesses, $40 million for government buildings, and $130 million for naval facilities. Guam has frequent ground trimmers.

- Guam’s Military Facilities must be designed to meet most current ASC 7 and other UFC codes that determines seismic design for Guam.
Example:

1. Rusted galvanized chain link next to existing 1963 housing.

2. In a new DB housing project, green colored vinyl covered aluminum chain link fencing and white vinyl fencing - used to resist the corrosive moist salt air.
At a 6 year old housing project, AC disconnects and the AC compressor is rusting from being exposed to the ocean wind carrying moist salt air.

Compressor has already been replaced.

Due to Guam’s marine corrosive environment, exposed hardware, fasteners, metal boxes, housings, metal doors and frames, etc. shall use 316L stainless steel.
Solid concrete half walls protect ground mounted outdoor equipment such as transformers, ac chillers and compressors from direct contact with wind born salt air and typhoon wind driven flying debris.
Example:

1. 1963 housing units – Rusting galvanized electric service boxes.

2. DB Project – Stainless Steel electric service boxes, unfortunately the fasteners were not. Also - telephone & CATV are plastic boxes. Notice the rust from a part not stainless steel. Stainless steel should be 316L to help meet Guam’s marine corrosive environment.
Corrosion & Wind Protection

This is the next evolution of corrosion & wind protection where the incoming electrical, telephone and cable service are protected by an exterior closet.

The exterior closet also allows for work access when the tenants are not at home.
4 – Guam has Termites

Termite Controls And Management Systems
Why Do We Want To Control Termites?

- Reduce damage caused by termites
- Maintain the structural integrity of buildings
- Protect our assets (Building/Contents)
- Huge economic toll (Estimated repair at approx. $1.5 billion a year)
- Reduce repair costs ($$$$
- Minimize down time for repaired facilities affected by termite damage
Termite Damage
Which Termites are we most concerned about?

“Coptotermes formosanus” – Formosan sub
Termite Controls and Management Systems

- Soil Treatment (Liquid Chemical)

- Ground bating for new construction and insecticide system

- Use of Selective Building Components—not using wood and wood bi-products (cellulosic)- such as aluminum cabinets, paperless, drywall, solid surface acrylic window sills, plastic trim, interior light gage G90 steel framing, non cellulosic insulation, etc.

- Design methods such as no CMU below grade, termite mesh barrier system at concrete joints, around conduits and piping coming through slab on grade, providing 6 inch exposed concrete above grade for inspections for ground termites and so forth.

- Termite Inspections

Note: Basaltic Termite Barrier is not available on Guam
Soil Treatment (Liquid Chemical Barrier)
Other Termite Management Systems

Use of a Baiting System

- Place bait stations loaded with untreated wood stakes around structure (typically 8’ o.c.)
Termite Mesh Barrier System
Termite Mesh Barrier System
E- Radon Mitigation System

Under the slab radon piping and this vent pipe are installed in each house during construction.

If testing shows radon gas, then a blower is then added to the vent pipe to vent the radon gas.

Finegayan and Anderson Air Force areas have limestone below grade. This is a good indication that high radon levels are present in the soils and that a radon mitigation system will be needed.