Wind-Borne Debris Hazards

At
The Colony
1620, Gulf of Mexico Drive
Longboat Key, Florida

Prepared for the

Town Commission of Longboat Key

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Wind-Borne Debris Hazards at the Colony, Longboat Key, Florida

Executive Summary

Author of this report spent sixteen hours on Friday Feb. 7, 2014 and Saturday Feb. 8, 2014 conducting an outdoor inspection of all the buildings at The Colony. The focus of the inspection was to identify the items and structural conditions that have the potential for generating wind-borne debris originating from The Colony and become a hazard for Longboat Key. Permission to enter the buildings for interior inspection could not be obtained because of privacy laws and the shuttered state of The Colony. Author took approximately four-hundred photographs to identify the hazards and to document the current state of the buildings.

The buildings directly along the coastline evidenced maximum deterioration that gradually reduced inwards from the coastline. All buildings had conditions, to varying degrees, with the potential for wind-borne debris in a tropical storm event. In general, the following conditions with the potential to generate wind-borne debris from structures currently existing on The Colony property were observed.

(1) The most dangerous hazards were found in the foundation systems of all eighteen elevated Villa buildings. These buildings are elevated two to four feet above grade by concrete-footing, concrete-piers, steel-I- beams and wood-beams. All these foundation components are load bearing structural members and carry the entire load of the building and transfer it to the ground below. Extreme corrosion of concrete-rebar, spalling of concrete-piers, corrosion of steel-I-beams, and rotting of wood-beams and wood-planks of flooring were observed. In several instances the failure of these columns led to tilt in the balconies above and settlement of wood-planks of elevated wood-decks. All parts of the foundation system are at the end of their functional service life, as explained in the section on corrosion of the full report. Failure of the foundation system can lead to sliding-off, overturning, or subsidence of the structure or part of the structure in an extreme wind event. These types of failures lead to breakage of building components and generate wind-borne debris.

(2) All structures in The Colony have unprotected windows that can be impacted by debris and create internal pressurization of buildings. Internal pressurization of building leads to failure of siding, roof-faming, windows, roof shingles and many other building components with the potential to become wind-borne debris.

(3) Extreme rotting and detachment of wood members and connectors of balconies at the upper level, all grade level and elevated walkways, stairs, elevated decks, hand rails, lattice skirting, wood shakes and wood siding, planter boxes, have the potential to become wind-borne debris.

(4) Loose and unsecured items, e.g., loose roof-gravel, broken and loose window-awnings, torn screen-enclosures, tree branches, loose and unsecured AC units, and other items on roofs have the potential to become wind-borne debris.

(5) Structural failures of many load bearing members, e.g., settlement and detachments of wood columns and beams, tilting of balconies, excessive deflection of wood beams, rot and detachment at support of wood beams have the potential to become wind-borne debris.

Based on these observations and in light of the fact that:

(i) these buildings have been exposed to a most corrosive and humid environment for the past forty years with minimal repair and maintenance;
(ii) these buildings do not have the latest hurricane resistant hardware, e.g., hurricane clips, brackets, straps and anchor rods;
(iii) all buildings have unprotected windows; and
(iv) The Colony has remained closed for the past four years with minimal or no responsible repair and maintenance;

it is concluded that in an elevated tropical storm event many building components from The Colony buildings have the potential to become wind-borne projectiles posing multiple threats to life and property on Longboat Key. It is also strongly recommended that these building be now categorized as Public Nuisance in accordance with applicable rules and regulations.

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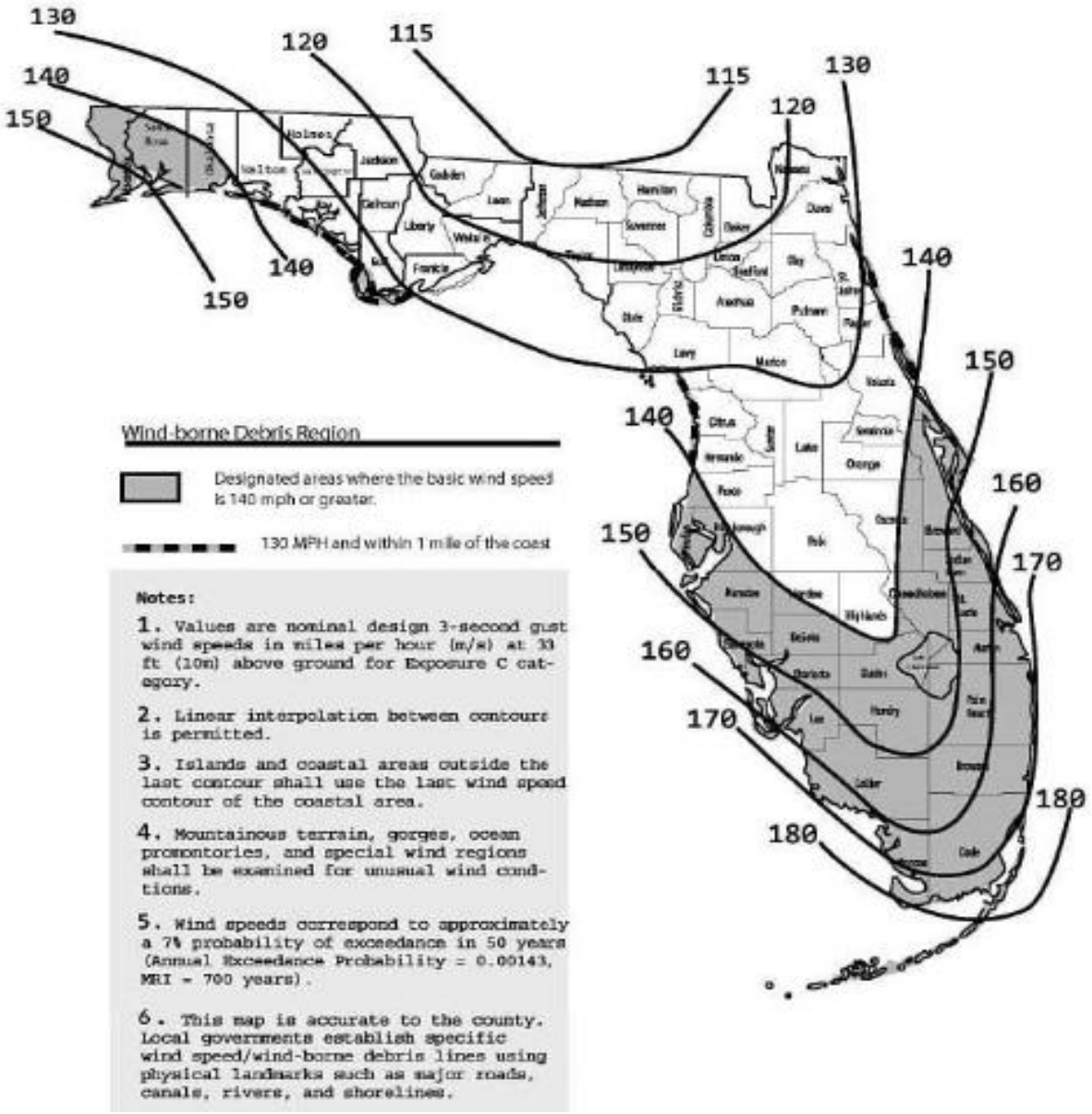
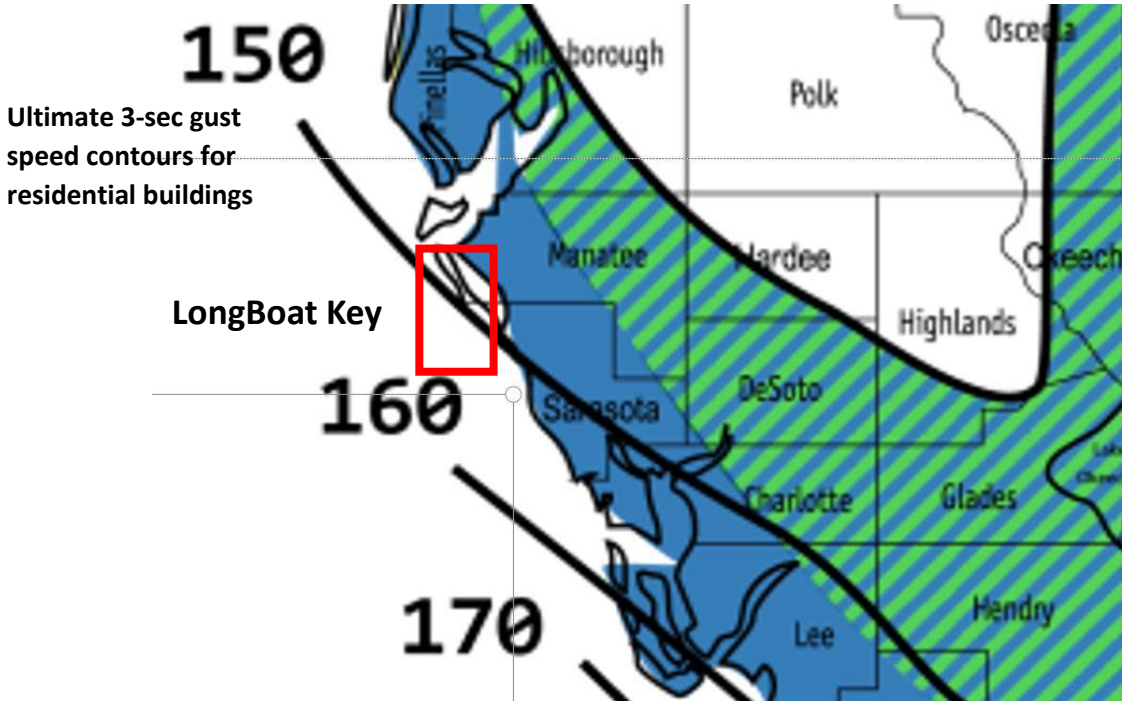
March 3, 2014

Wind Maps, Wind Loads and Debris Impact Standards
For the Long-Boat Key

The Florida Building Code 2010 (FBC 2010) shows wind speed maps as well as debris regions for all State of Florida. These maps are revised on a three year cycle and are based on hundreds of wind speed data reports, research papers, damage documentation studies, modelling and actual data gathered by National Hurricane Center and National Weather Services, e.g., NOAA. These maps reflect the latest scientific knowledge on wind speeds and wind resistant design.



These wind maps are used for new construction and are not applicable to older buildings such as those at The Colony. However, building officials and town managers should use these maps, wherever possible, to enhance the safety and security of the public.



Longboat Key is a barrier island west of Sarasota in Southwest Florida. The current wind speed map for design and construction of residential buildings, similar to the The Colony buildings, is 150 mph. It is noted that these maps show life-cycle ultimate 3-second gust speeds as failure of building components is clearly tied to three second gusts rather than fastest mile wind speeds. During 1960s and 1970s the design winds was specified in fastest mile and 150 mph 3-secod gust speed is approximately equal to 133 mph fastest mile wind speed.

It is also noted that the wind-borne debris regions have increased for Florida in the last three code revision cycles. All counties south of Lake Okeechobee and many coastal counties now require window protection and debris resistant shutters for new construction. Florida Building Code does make an exception to debris resistant shutters by allowing use of wood panels so that this requirement does not become financially burdensome for general public. However, after suffering damage from Hurricane Andrew, Dade and Broward counties chose to disallow use of wood-panels and require all new buildings to have shutters that meet the large and small missile standards as well as pressure cycle standards contained in FBC 2010.

Wind-borne Debris Standards for the LongBoat Key

Many wind damage documentation studies have revealed that in a wind storm many items, e.g., timbers, roof tiles, sheathing panels, shingles, siding, sheet metal, bricks, trash cans, screen enclosures, AC units, etc., get picked up and are hurled to varying heights and distances.

The science behind the wind-borne debris is not exact and it is estimated that the large missiles can fly or tumble near ground at one-third to one-half of the prevailing fastest mile wind speed.

In addition to large debris, wind storms also generate small missiles by picking up roof gravel, small items, and glass particles that fly at rooftop elevations with impact speeds up-to 90% of prevailing average (fastest mile) wind speed

Federal Emergency Management Agency (FEMA) has developed a Coastal Construction Manual that says: Wind loads and wind-borne debris are both capable of causing damage to a building envelope. Even small failures in the building envelope, at best, lead to interior damage by rainfall penetration and winds and, at worst, lead to internal pressurization of the building, roof loss, and complete structural disintegration. The figure below, from the Coastal Construction Manual illustrates that flying debris can penetrate unprotected windows and the internal pressure can cause major structural damage to roof components as well as building components.

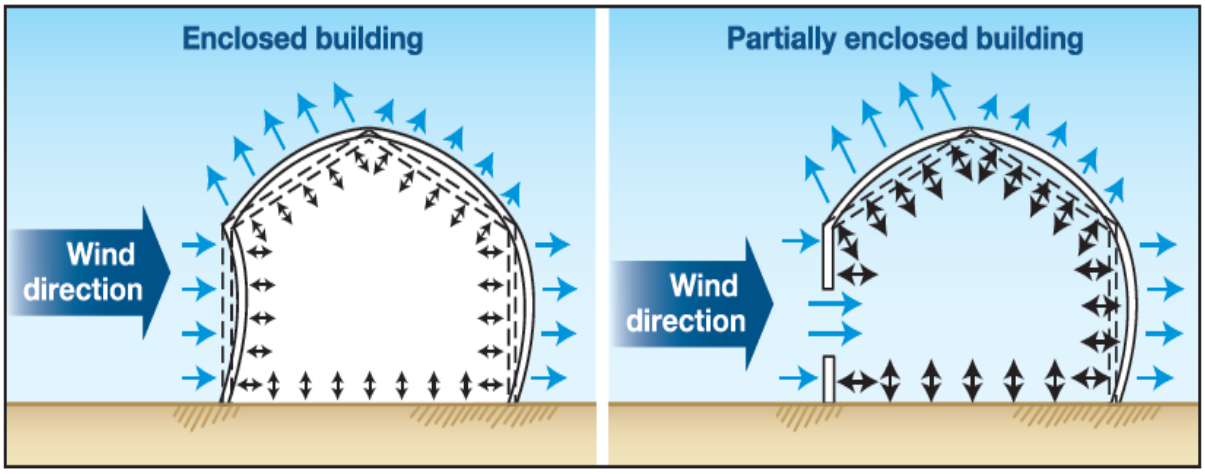


Figure 8-17.
Effect of wind on an enclosed building and a building with an opening

Sparks et al. (1994) investigated the dollar value of insured wind losses following Hurricanes Hugo and Andrew and found the following: Most wind damage to houses is restricted to the building envelope Rainfall entering a building through envelope failures causes the dollar value of direct building damage to be magnified by a factor of two (at lower wind speeds) to nine (at higher wind speeds) Lower levels of damage magnification are associated with water seeping through exposed roof sheathing (e.g., following loss of shingles or roof tiles). Higher levels of damage magnification are associated with rain pouring through areas of lost roof sheathing and through broken windows and doors

Large and Small Missile Tests as per FBC 2010

A. Large-Missile Test

A product exposed to various impacts with a piece of lumber weighing approximately 9 pounds, measuring 2" x 4" x 9' in size, traveling at a speed of 50 feet per second (34 mph).

B. Small-Missile Test

A product that has been exposed to various impacts with 10 ball bearings traveling at a speed of 80 feet per second (50 mph). The product is then subjected to wind loads for 9,000 cycles. If the doors and windows are more than 30 feet from the ground then they must be either large or small missile compliant.

C. Cyclic Pressure Test

To simulate the wind environment for the impact resistant windows or shutters these components are also subjected to a cyclic pressure test as described in the table below.

The P_{max} pressure is the maximum design pressure for that component. Each cycle has to achieve the upper and lower pressures as indicated in the table.

Inward Acting Pressure		Outward Acting Pressure	
Range	Number of cycles	Range	Number of cycles
$0.2P_{MAX}/0.5\ P_{MAX}$	3,500	$0.3P_{MAX}/1.0\ P_{MAX}$	50
$0.0\ P_{MAX}/0.6\ P_{MAX}$	300	$0.5\ P_{MAX}/0.8\ P_{MAX}$	1,050
$0.5\ P_{MAX}/0.8\ P_{MAX}$	600	$0.0\ P_{MAX}/0.6\ P_{MAX}$	50
$0.3\ P_{MAX}/1.0\ P_{MAX}$	100	$0.2\ P_{MAX}/0.5\ P_{MAX}$	3,350

An impact resistant glass going through a pressure cycle test to simulate the hurricane wind pressure cycles in a lab.

Corrosion of Concrete Rebar and Structural Steel in Salt-laden Coastal Areas

The most dangerous wind-borne debris hazard found at The Colony was the extreme corrosion of the foundation system, e.g., rebar of concrete piers and corrosion of structural steel beams. Chloride attack on steel, rebar, and structural steel, is a well-known phenomenon. Chloride ions get into concrete pores and then attack the rebar to form rust. The rust is about seven times the volume of steel and so it exerts outward pressure on the surrounding concrete leading to cracks and spalls in beams, columns, footings and slabs. The aerosol salt spray on the coastal buildings is generated by winds that blow landward from the sea and the breaking waves. The corrosion rates in coastal areas are much higher than inland areas. Several text books, research publications, as well as government agencies have documented the high corrosion rates in coastal areas. The tables, charts and graphs presented below establish the fact that corrosion rates in coastal salt laden environment are much higher when compared to inland areas.

FEMA Publication 8-96, Corrosion Protection for Metal Connectors in Coastal Areas, was reviewed and the following short paragraphs are worth noting. The publication is available at http://www.fema.gov/media-library-data/20130726-1511-20490-8204/corr.pdf

Causes of Corrosion Near the Ocean

The conditions that accelerate corrosion near the coast have been studied in a few corrosion field stations and research laboratories around the world. Several of these conditions occur along most shorelines. Understanding the causes of accelerated corrosion can help identify some of the worst corrosion exposures that affect coastal buildings.

Salt Spray from Breaking Waves and Onshore Winds

Salt spray from breaking waves and onshore winds significantly accelerates the corrosion of metal connectors. The ocean salts, which are primarily sodium chloride but include other compounds, accumulate on the metal surfaces and accelerate the electrochemical reactions that cause rusting and other forms of corrosion. The combination of salt accumulation on the surface and the high humidity common to many coastal areas significantly accelerates the corrosion rate of steel and other metals commonly used for connectors or other building materials. The longer a surface remains damp during normal daily fluctuations in humidity, the higher the corrosion rate. Onshore winds carry both salt and moisture inland. Therefore, corrosion rates along shorelines with predominately onshore winds will be higher than those along shorelines with predominately offshore winds.

Corrosion Rates of Various Inland and Coastal Locations in the United States

The corrosion rate is measured in, µm/year (micrometers/year), and is a world-wide accepted unit of measurement. A rate of 1000 micrometers/year is considered an extremely high corrosion rate and means the metal surface will lose one thousand micrometers (or one millimeter) of thickness per year. Technically, at this rate an inch-thick-steel-plate will lose half of its thickness in thirteen years of completely open exposure.

The following Table from the FEMA publication, Steel Bridge Design Handbook, compares the corrosion rates in various locations within the United States. For example corrosion rate in Phoenix, Arizona is 6.6, whereas at Cape Kennedy, Florida Beach this increases to 1057, which is 160 times higher than that of Phoenix, Arizona. This publication is available at

http://www.fhwa.dot.gov/bridge/steel/pubs/if12052/volume19.pdf

The corrosion rates in the table do not include sheltering effects given by floor, walls, concrete cover and other site specific barriers. In any case the table does explain the multiplier effect that may be observed in various locations under similar sheltering effects.

Table 1 Corrosion Rates for Carbon Steel at Various Locations

Location	Environment (macro)	Section loss (µm) 1 yr	Section loss (µm) 2 yr
Phoenix. AZ	rural	6.6	9.2
Vancouver, B.C.	rural-marine	17.3	26.7
Detroit, MI	industrial	23	28.9
Potter County, PA	rural	21.8	41.1
State College, PA	rural	25.1	45.9
Durham, N.H.	rural	35.4	54.7
Middletown, OH	semi-industrial	36.2	57.6
Pittsburgh, PA	industrial	42.8	61.3
Bethlehem, PA	industrial	55.1	75.3
Newark, NJ	industrial	72.4	102
Bayonne, NJ	industrial	127	155
East Chicago, IN	industrial	111	169
Cape Kennedy, FL 0.8 km from coast	marine	41.1	173
Brazos River, TX	industrial-marine	107	187
Cape Kennedy, FL 54m from coast, 18 m elevation	marine	61.3	263
Kure Beach, NC 240 m from the coast	marine	85.1	292
Cape Kennedy, FL 54m from coast, 9 m elevation	marine	70.8	330
Daytona Beach, FL	marine	209	592
Cape Kennedy, FL 54 m from coast, ground level	marine	191	884
Point Reyes, CA	marine	315	1004
Kure Beach, NC 24 m from the coast	marine	712	1070
Cape Kennedy, FL beach	marine	1057	

Corrosion Rate for Steel in Concrete with Chloride Contamination and Relative Humidity

Concrete in coastal areas is heavily contaminated by chloride ions and has high relative humidity. It may be noted that beside chloride ion concentrations, the relative humidity also has a profound effect on corrosion rates. The rebar in concrete in The Colony buildings next to the shoreline can be assumed to have corrosion rates between 100 to 1000 µm/per year.

All concrete members with rebar, e.g., footings, piers, beams, slabs, concrete masonry units, will have chloride contamination to some degree. In this corrosive environment even the structural members without visible cracks or spalls may also be structurally unsafe. These members will have some corrosion that has accumulated over the past forty years of exposure. The spalling of concrete in some piers indicates that spalling will start in other piers as well. In many building up-to 75% of the foundation piers show cracking.

The following graph from a well-known text book on corrosion supports the finding of FEMA and the Table of US Corrosion Rates presented previously. This text book can be found at

http://www.amazon.com/Corrosion-Steel-Concrete-Prevention-Diagnosis/dp/3527331468/ref=sr_1_1?s=books&ie=UTF8&qid=1393348252&sr=1-1&keywords=corrosion+of+steel+in+concrete

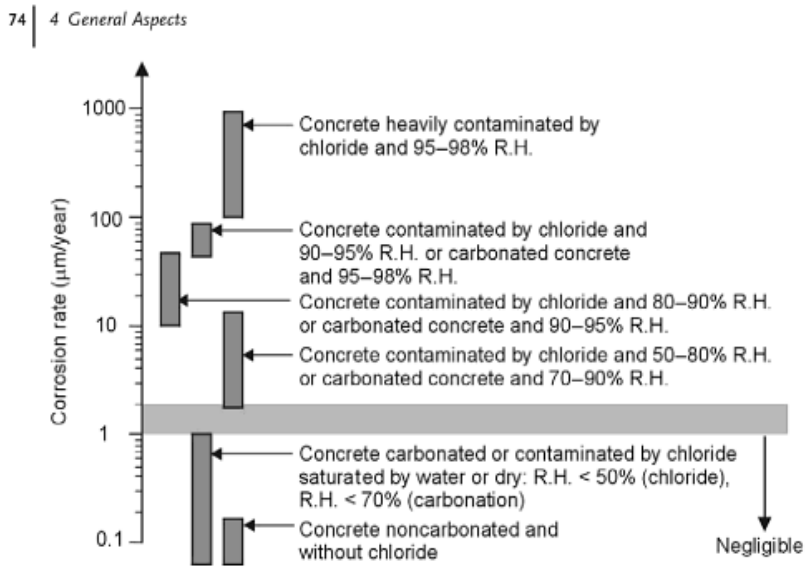


Figure 4.2 Schematic representation of corrosion rate of steel in different concretes and exposure conditions (after [9], modified).

Corrosion of Steel in Concrete: Prevention, Diagnosis, Repair, Second Edition. Luca Bertolini, Bernhard Elsener, Pietro Pedeferri, Elena Redaelli, and Rob Polder.
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Increase in Corrosion Rates of Rebar in Concrete with Exposure Time

It is noted that for rebar the corrosion rate and cumulative corrosion damage increases exponentially when the protective passivation layer is destroyed. The following three figures, one from a corrosion text book; one from a FEMA publication; and the third from a leading industrial company are presented.

It is noted that most of the concrete components in The Colony buildings have reached the spalling stage described in the curve or will reach the spalling stage very soon. The service life of these concrete members, which have been exposed to this corrosive environment for forty five years, is almost over. The graph below is from the same text described in the last section and clearly shows the corrosion accumulation in rebar with time.

72 | 4 General Aspects

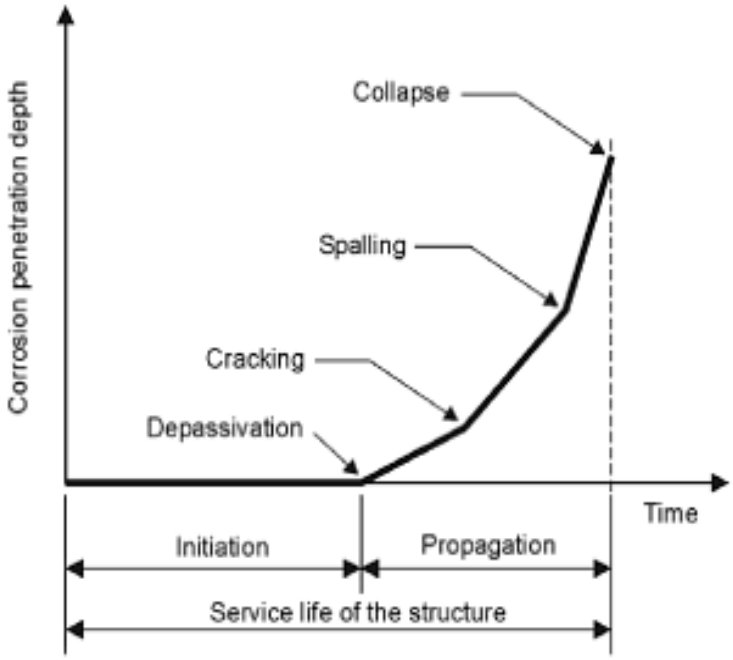

Figure 4.1 Initiation and propagation periods for corrosion in a reinforced concrete structure (from Tuutti's model) [7].

Corrosion of Steel in Concrete: Prevention, Diagnosis, Repair, Second Edition. Luca Bertolini, Bernhard Elsener, Pietro Pedeferri, Elena Redaelli, and Rob Polder.
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The graph below is from a FEMA publication and is freely available at the web address provided. This curve also describes the corrosion effect with respect to time which is quite similar to the previous graph.

The graph essentially illustrates that the functional service life of a concrete member ($F_{t.}$) is comprised of the time needed for crack initiation (T_i), plus the time for crack propagation (T_p), and the time needed for further damage (T_d) due to spalling.

(1)Time for **corrosion initiation**, T_i.

(2) Time, subsequent to corrosion initiation, for appearance of cracking on the external concrete surface (**crack propagation**), T_p; and

(3) Time for surface cracks to progress into further damage and develop into spalls, T_d, to the point where, if repairs and rehabilitations are not performed, **the functional service life, T_f**, is reached

Or $F_{t.} = T_i + T_p + T_d$.

Also note that T_i is the longest time component whereas T_d is the shortest time component. The time before failure after crack propagation is very brief and illustrates the exponential nature of the cumulative damage.

http://www.fhwa.dot.gov/publications/research/infrastructure/bridge/07039/chap1.cfm

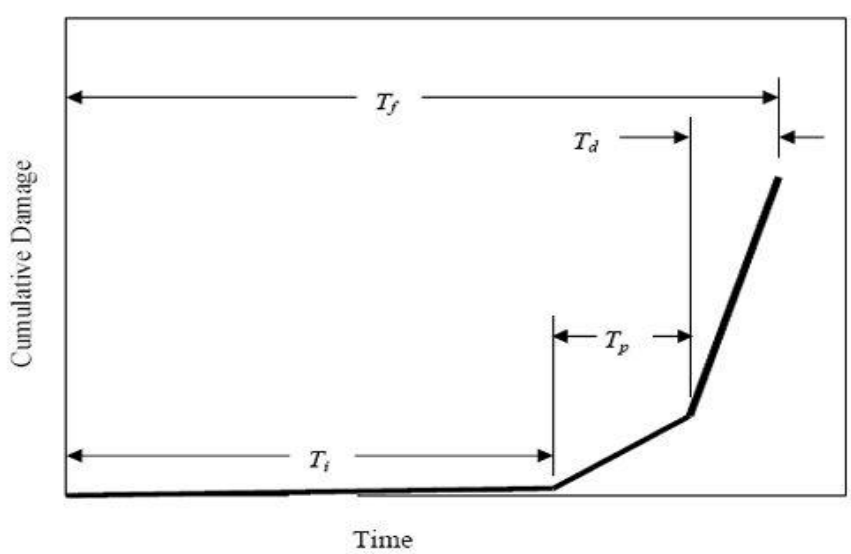
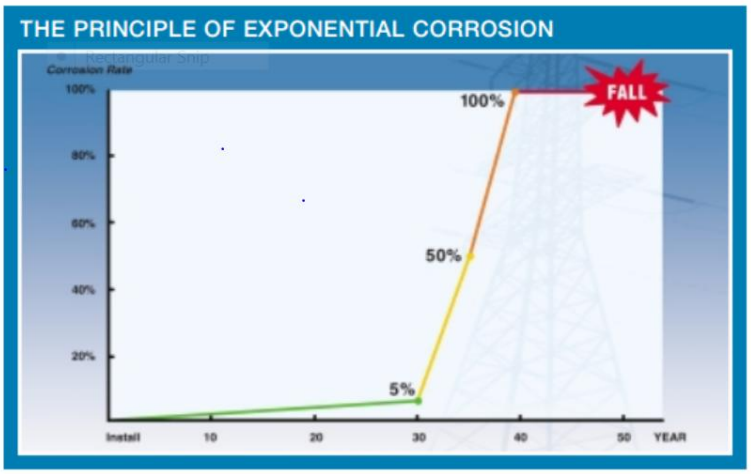
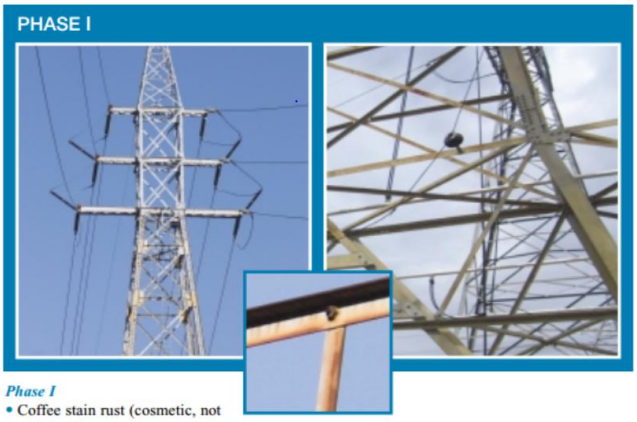


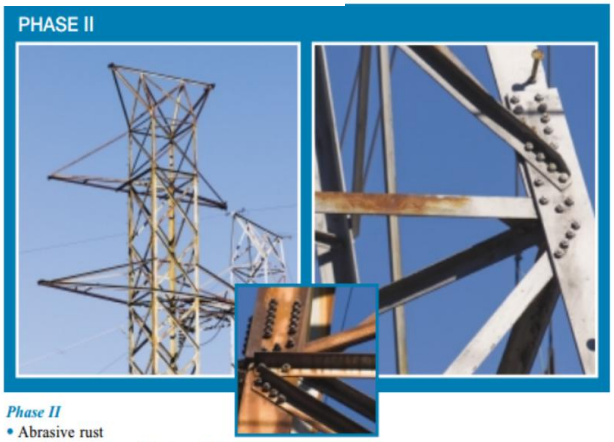
Figure 1.2. Schematic illustration. Various steps in deterioration of reinforced concrete due to chloride induced corrosion

PPG industries has also published a white paper on corrosion and service life of steel transmission towers and is quite relevant for this report. The paper is available at http://www.ppg.com/en/newsroom/news/Documents/TransTower_Paper.pdfand supports their cumulative exponential corrosion curve with photographic documentation.





Phase I
- Coffee stain rust (cosmetic, not structural)
- 5% rust
- On edges and bolts
- Approximately 1-2 mils of galvanization remains



Phase II
- Abrasive rust
- On bolts, edges and horizontal flat areas
- Rust falls off on touch

Phase III
- Extensive, abrasive rust

Phase IV
- The tower falls

Extreme Corrosion and Spalling of Concrete Piers at The Colony

The following pictures generally illustrate the failing state of structural load carrying piers under most of the villas and other buildings. These piers are very important structural members and transfer the entire load of the building to the ground below. In the current spalling stage these piers can collapse at any time and create a dangerous situation for occupants or repair workers. In a hurricane situation the building can slide off these failed footings and create structural damage leading to wind debris damage.

THESE TWO PICTURES SHOW EXTREME SPALLING OF CONCRETE AS WELL AS CORROSION OF REBAR. THE LOAD CARYING STRENGTH OF THESE PIERS IS REDUCED TO THE POINT THAT THEY ARE CRUMBLING AND CAN COLLAPSE ANY DAY. THE PRESENT CONDITION OF THESE PIERS INDICATES THAT FAILURE IS IMMINENT FOR AN EXTREME FLOOD OR WIND EVENT AS SHOWN BELOW IN HURRICANE KATRINA.

Failure of house connections to foundation below led to sliding off of a house in Hurricane Katrina

Extreme Corrosion of Structural Steel members at The Colony

The following pictures generally illustrate the state of corrosion of structural steel, e.g., I-beams, steel plates, steel pipes, etc., at The Colony. These steel members are very important structural members and transfer the entire load of the building to the foundation system below. The current corrosion stage of these members indicates that these can fail at any time and fall two or three feet to the ground. The failure of these beams can create a dangerous situation for occupants or repair workers. In a hurricane situation these building components can fall off and bring the building above partly or fully to the ground and create structural damage leading to wind-borne debris.

The two picture below are from The Colony. The third picture is of a corrosion study.

An example of extreme corrosion of structural steel angles presented by a corrosion researcher. Note that whole thickness can corrode

Service Life of Coastal and Inland Buildings

The buildings in a coastal environment have much shorter life-spans than the comparable buildings located further inland. Coastal buildings are impacted by much higher environmental loads, e. g., chloride attack leading to corrosion of steel; higher variation in temperatures, humidity, and UV rays; higher wind speeds and debris impact; higher flood levels, velocities, and erosion; and severe wind driven rain. The Colony in the Longboat Key is located in the coastal high-hazard area. All buildings in The Colony are subjected to these higher environmental loads.

In general, homes in coastal high-hazard areas must be designed and built to withstand higher loads and more extreme conditions. Homes in coastal high-hazard areas will require more maintenance and upkeep. It is an established fact that because of their exposure to higher loads and extreme conditions, homes in coastal areas will cost more to design, construct, maintain, repair, and insure. Inspection of The Colony buildings revealed that maintenance and repair of the buildings was minimal to non-existent for the past several years. The lack of maintenance and repair has made these buildings hazardous in a wind or a flood event. Although internal inspection of The Colony building could not be carried out, it is quite possible that with the lack of air-conditioning and high humidity levels, these buildings have mold, mildew and other organic growth in attic and walls that may classify these as sick buildings as well. Infra-red thermography for moisture penetration is also recommended as part of any assessment prior to a determination of safe occupancy.

Various FEMA publications emphasize that in coastal areas (i) buildings must be designed to withstand coastal forces and conditions, (ii) buildings must be constructed as designed, (iii) buildings must be sited so that erosion does not undermine buildings or render them uninhabitable, and (iv) the buildings must be maintained/repaired.

Inspection of The Colony buildings revealed all concrete, wood and structural steel construction materials show sign of distress as follows:

(i) Concrete piers and beams show rebar corrosion; shear, bending and compression cracks; spalling, cracking and extreme deflections; and delamination.

(ii) Wood members of grade-walkways, elevated-decks and stairs show extreme deterioration, cracking, delamination, rotting and settlement.

(iii) Steel connectors, nails, bolts, welds and bearing plates show rust. All steel beam have corroded to varying degrees, some to an extent that the entire thickness of the web or flange of the structural steel beam is corroded.

(iv) Exterior concrete sidewalk slabs adjacent to buildings near the coastline have cracked and heaved and raise doubts about the bearing capacity of the soil underneath them as well as under the buildings.

Paint Deterioration in Coastal Climates

Exterior paint for residential wood frame buildings is one of the cheapest and effective barriers to preserve wood from cracking, mold and mildew growth and wood-rot. Frequent exterior painting of wood members in the coastal environment is even more important because of the higher environmental loads as explained in the previous sections.

The research findings published in a research paper 'Performance and Resistance of Paint used as Exterior Finish in Salt Laden Environment,' available at the following website are provided below:

http://www.emeraldinsight.com/journals.htm?articleid=17090555&show=abstract

Findings – It shows that paint used in an environment where saline air and salt is prevalent begins to deteriorate after two years and requires repainting as against the established norm of five to seven years (5-7) in areas that are not exposed to saline air. The impact of saline air is significant at $p<0.01$, or 99% statistical reliability.

Exterior paint of residential buildings not in a coastal saline environment also deteriorates because of (i) Ultra Violet (UV) rays, (ii) high humidity, and (iii) extreme temperature cycles, and may require re-painting in five to ten years. However, paint in coastal areas with an abundance of saline air and salt begins to deteriorate after only two years and requires repainting. On the coast, marine fog and drizzle act as vehicles that soak home exteriors with salt. When this 'salty' moisture dries out on a house, the dissolved salt recrystallizes and slowly peels away paint. Degradation of paint leads to moisture attack and mold formation and cracking of the wood underneath. The Colony buildings had minimal maintenance and the exterior paint of all buildings was found to be extremely damaged as evidenced by chipping, peeling, blistering, and excessive formation of mold in wood members as shown below.

Wind-Borne Debris Hazards at The Colony

Villa 1
Flying debris hazard
Posed by extreme rotting and falling off of wood siding

Villa 1
Lattice skirting is loose and can Detach and fly-off in a wind event. All villa buildings have the lattice skirting debris hazard

Villa 1
Flying debris hazard posed by soffit panel

Wind-Borne Debris Hazards at The Colony

Villa 5

Many exterior HVAC Units were found to be broken around Villa Buildings

Villa 1

This picture shows extreme rotting in the wood panels below the hand rails. All these panels are a flying debris hazard in a wind event

Villa 3

The awnings of all Villa buildings are in extremely poor condition. Many have already fallen to the ground. Certainly a debris hazard in wind

Wind-Borne Debris Hazards at The Colony

Villa 5

Wood planks of elevated deck failing and showing extreme settlement. Detachment of these failed members poses a flying debris hazard

Villa 6

Ultimate failure of balcony beam with shear cracks. Picture also shows the compression cracks in the wood post

Villa 7

Extreme rot, settlement and support failure of the wood staircases

Wind-Borne Debris Hazards at The Colony

Villa 8

Rotted and failed top connection. The post was originally connected at the hollow square

Castaways

Tilt in the AC unit support as well as in the wall. Such extreme tilts lead to failed connections, are due flooding and may get wind-borne.

Beach Units

Failure of wood trellis at the Beach Units. A connection, as shown, that can fall apart with very little impact is a debris hazard

Wind-Borne Debris Hazards at The Colony

Restaurant

Loose roof-gravel found at the restaurant building. Loose roof-gravel has been documented as a major threat for commercial buildings

Lanai Units

Loose roof-gravel found at the lanai units. Loose roof-gravel has been documented as a major threat for breakage and penetration of glass windows

Flower shop

Loose roof-gravel found at the flower shop building. Loose roof-gravel has been documented as a major threat for breakage and penetration of glass windows.

Majar Structural Debris Hazards at The Colony

Major Structural Hazards

These pictures show major structural hazards founds at The Colony. These include (i) compression failure of piers (ii) Corrosion of welded connections and steel beams (iii) connection failure of wood beams, (iv) extreme settlement of wood beams supporting balconies and (v) rotting of floor beams

Major Structural Debris Hazards at The Colony

Beach Units 1B, 2B, 3B	Corrosion in concrete bond beam in rear; Heaving of walkway slab; Bearing capacity and flooding issues; Extreme rotting of wood trellis beams; Holes in wall around pipes; AC units completely corroded and are debris hazards; Splice in trellis beam has failed; Trellis has also damaged the roof; All exterior wood in extreme distress
Lanai Units	Roof-gravel, and window planters are debris hazard; Extreme rotting of all elevated wood deck; Cracking in joints of foundation columns; Most concrete foundation pies are extremely damaged; Exterior wood work debris hazard; AC units also not working and are debris hazard; Exterior wood shakes are debris hazard
Restaurant Complex	Roof gravel, wood in stairs decks, hand rails, screen enclosures, are debris hazard; Many loose items in and around as well as on roof that are debris hazards; Structural steel beams and connections are deteriorating; Elevated deck panels are debris hazard; Loose items around the pool area; Many wood posts have failed or are tilting
Beachcomber	Window and door grid breaking away; Rear deck fractured, shifted and rotted; Rim board coming off; Steel connectors to columns and rim board failing; Extreme distress in all exterior work
Vagabond/ Beachview	Awnings and AC units have failed; Deck surface warping-up; All wood work shows signs of insect damage, holes and extreme deterioration that make them debris hazard
Castaways	Masonry Column supports to the building are failing; Extreme deterioration of exterior wood work; Insect damage to wood work; All exterior woodwork has failed joints that makes it debris hazard;
Mid-Rise	Tall steel frame buildings; Few instances of deterioration; Extreme corrosion of open-web bar joists; Parapet cracking; Corrosion on exterior steel items; Some fabric canopies are wind-borne debris hazard
Villa 1	Wood panels on balconies show extreme rot; Extensive spalling fissures and fractures in about 75% of piers; Rebar exposure on 40%; AC units showings signs of failure; Bottom of I-beams failing by corrosion and rusting; Many wood porch beams deflected more than ½ inch; Extreme distress, rot and cracking in all outside wood members as well as termite damage; Cast iron drains broken; Damaged window awnings; Security fencing is pushed
Villa 2	Extreme distress, rot and cracking in all outside wood members as well as termite damage Extensive spalling fissures and fractures in about 60% of piers; Rebar exposure on 40%; Fatigue in AC units; Bottom of I-beams failing by corrosion and rusting; Many porch beams deflected more than ½ inch; Cast iron drains broken; Lattice skirting falling from position; Damaged window awnings

Villa 3	Railing pulling from walls; Wood post failure; Extensive spalling fissures and fractures in about 50% of piers; Rebar exposure on 20%; Fatigue in AC units and unit stands; Bottom of I-beams failing by corrosion and rusting; Many porch beams deflected more than ½ inch; Extreme distress, rot and cracking in all outside wood members as well as termite damage; Cast iron drains broken; Lattice skirting falling from position; Damaged window awnings
Villa 4	Extensive spalling fissures and fractures in about 35% of piers; Rebar exposure on 15%; Connection poles to shutters failing; Fatigue in AC units and unit stands; Bottom of I-beams failing by corrosion and rusting; Many porch beams deflected more than ½ inch; Extreme distress, rot and cracking in all outside wood members as well as termite damage; Cast iron drains broken; Lattice skirting falling from position; Damaged window awnings
Villa 5	Extensive spalling fissures and fractures in about 35% of piers; Rebar exposure on 15%; Connection poles to shutters failing; Fatigue in AC units and unit stands; Bottom of I-beams failing by corrosion and rusting; Many porch beams deflected more than ½ inch; Extreme distress, rot and cracking in all outside wood members as well as termite damage; Cast iron drains broken; Lattice skirting falling from position; Damaged window awnings
Villa 6	Many porch beams deflected more than ½ inch; Extensive spalling fissures and fractures in about 35% of piers; Rebar exposure on 15% of piers; Connection poles to shutters failing; Fatigue in AC units and unit stands; Bottom of I-beams failing by corrosion and rusting; Extreme distress, rot and cracking in all outside wood members as well as termite damage; Cast iron drains broken; Lattice skirting falling from position; Damaged window awnings
Villa 7	Spalling corrosion fissures and fractures in half of the piers; Steel I-beams show corrosion; Many AC units failing; Exterior wood item showing extreme distress to the point d debris hazard; Splits and cracks in deck joists; Holes in siding; Lattice skirting beginning to fail
Villa 8	About 60% of concrete piers showing spalls, fissures, cracks and corrosion; Bottom flange of I-beams showing corrosion; Many porch beams deflected more than ½ inch; Splits and cracks in some deck joists; Exterior wood showing signs of rot, holes, extreme settlement and insect damage; Lattice skirting dislodged from its position
Villa 9	Spalls, fissures, cracks and corrosion in 60% of piers; Bottom of I-beams show rust Exterior wood showing extreme distress; Connection of wood post failed leading to shift on wood post alignment; Many elevated deck members show extreme settlement; AC units lying unanchored on the ground
Villa 10	Column post moved and tilted; AC units toppled over; More than 50 % of concrete piers showing signs of spalling, cracking and corrosion; Exterior woodwork shows extreme distress including signs of termite and insect damage
Villa 11	Wood post failure; Extreme deformation is elevated deck; Exterior wood shows paint damage, rotting, insect damage; About 40 % of concrete piers show spalling, corrosion, fractures and fissures; Steel I-beams show signs of corrosion; Many porch beam deflected more than ½ inch; Termite and insect damage; Wood siding, trim, awnings show signs of distress; AC units may fall

Villa 12	More than 60 % of concrete piers show signs of spalling, fissures, fractures and corrosion; Steel I-beams show corrosion; Awnings are falling apart; Failure of AC unit stands; Rot in wooden boards; Many porch beams deflected more than ½ inch; Termite an insect damage
Villa 13	Failure of AC stands; Rot in elevated decks and wood posts; Many porch beams deflected, Upper walkway showing extreme rot; About 40% of concrete piers shows signs of deterioration and corrosion Exterior wood has rot, termite and insect damage
Villa 14	Connection failure of stairs beam; Rot in siding; About 30% of piers showing spalling, corrosion and fractures; Steel-I-beam corrosion
Villa 15	Failure of awnings and wood lattice skirting; Deck settlement; About 40% of concrete piers show signs of deterioration and corrosion; Siding and wood trim show extensive deterioration
Villa 16	Parts of window awnings breaking away; Many concrete piers showing signs of spalling and corrosion; Steel I-beams corroding, Extreme rot n wood is observed; All outside woodwork show sign of distress
Villa 17	Lattice skirting failure; AC units have corrosion; Spalling, cracks and corrosion in concrete piers; Rot in siding; Many porch beams deflection, deterioration of exterior wood-work; Exterior wood has deterioration and many detached and dislodged items; One AC unit has dropped to ground
Villa 18	Wood Panel on Balconies show extreme rot; Extensive spalling fissures and fractures in about 75% of piers; Rebar exposure on 40%; AC units showings signs of failure; Bottom of I-beams failing by corrosion and rusting; Many wood porch beams deflected more than ½ inch; Extreme distress, rot and cracking in all outside wood members as well as termite damage; Damaged window awnings; Security fencing is pushed
Conference Center	Minor fissure in masonry walls; Deterioration of fabric canopy; Deterioration of wood siding, roof sheathing trim and doors
House Keeping	Exterior wood and fabric canopy show sign of deterioration; Signs of termite damage; One shed roof is collapsing; Siding damage
Maintenance	Siding fascia boards trims and doors show signs of deterioration; Door connection failure
Sales	Exterior wood deterioration; Canopy frames are rusted; Detached doors; Rear deck waking surface uneven due to heaving and rot