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Structural Evaluation of Pipe Leg Tower and the Engineering and Execution of Controlled Demolition of Guyed Towers

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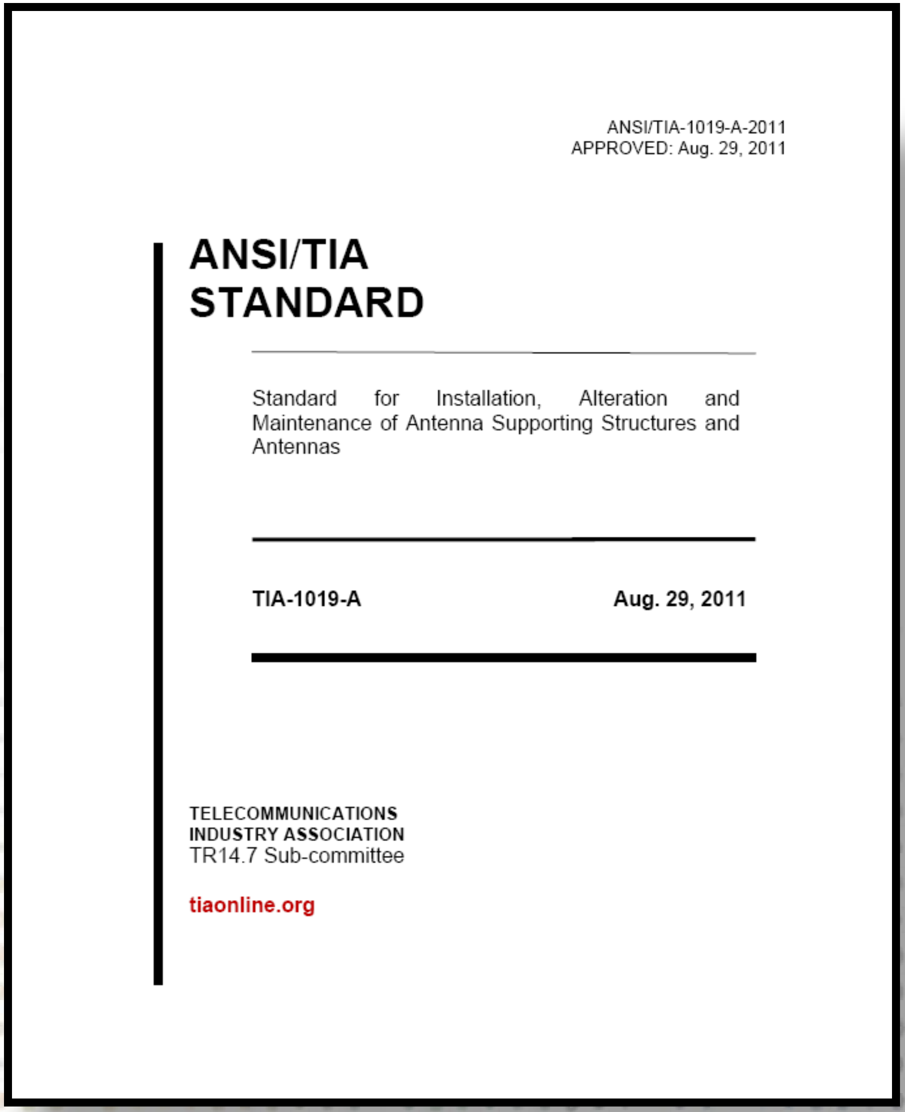
ANSI/TIA-1019-A-2011:


ANSI/TIA-1019-A-2011
APPROVED: Aug. 29, 2011

ANSI/TIA STANDARD

Standard for Installation, Alteration and Maintenance of Antenna Supporting Structures and Antennas

TIA-1019-A **Aug. 29, 2011**

TELECOMMUNICATIONS INDUSTRY ASSOCIATION
TR14.7 Sub-committee

tiaonline.org

Approved August 2011

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TIA-1019-A Minimum Strength Req's:

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Loads to be Considered:

1) **Operational Loads:**

***Rigging System Loads During Construction**

***Uniform 30MPH Wind**

2) **Non-Operational Loads:**

***Rigging System Loads Applied While Construction is NOT in Progress (i.e. Overnight, Down Days, etc.)**

***Reduced Wind Load Ranging Between 50-100% of Design Wind Speed (Not Exceeding 90MPH)**

Non-Operational Loads Generally Govern

Minimum Strength Conditions:

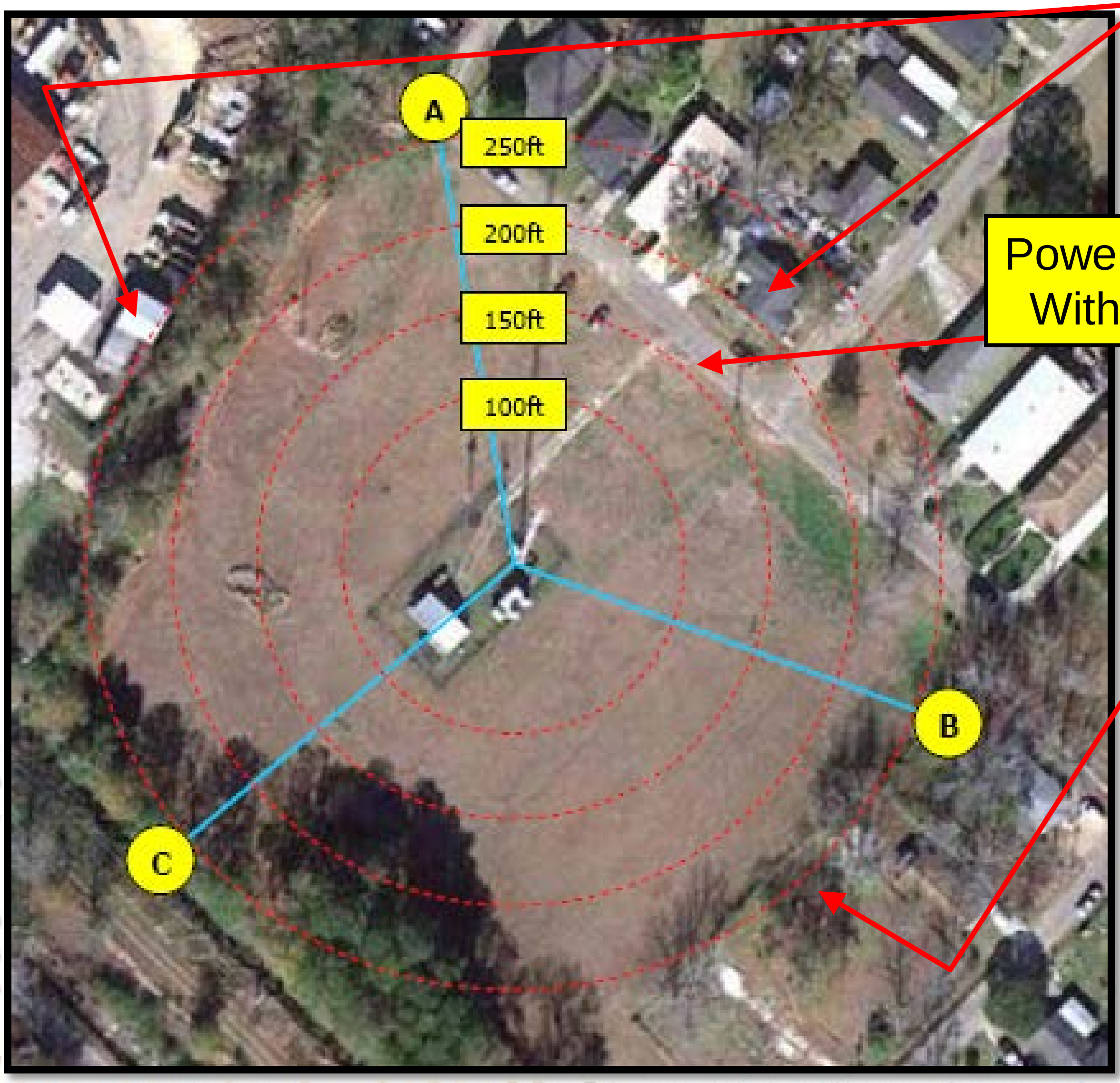
If a tower cannot be verified with a reasonable degree of engineering to meet minimum strength conditions of TIA 1019-A, personnel should **NOT** be on or around the tower during construction.

This situation leaves very limited options!

Subject Project:

- 490' Guyed Tower Located in Congested Residential Area (6 Guy Levels/50% Guy Radius)
- Local Crew Noted Severe Corrosion While Preparing to Rig Tower for an FM Install
- ERI Conducted Initial Climbing Inspection and Condition Assessment
- Performed Deterioration Analysis of Tower in Accordance with TIA-1019-A
- Prepared Engineered Rigging Plan to Safely Deconstruct Mast ~ Controlled Drop
- Executed Plan With Onsite Engineering Supervision

Congested Residential Area:



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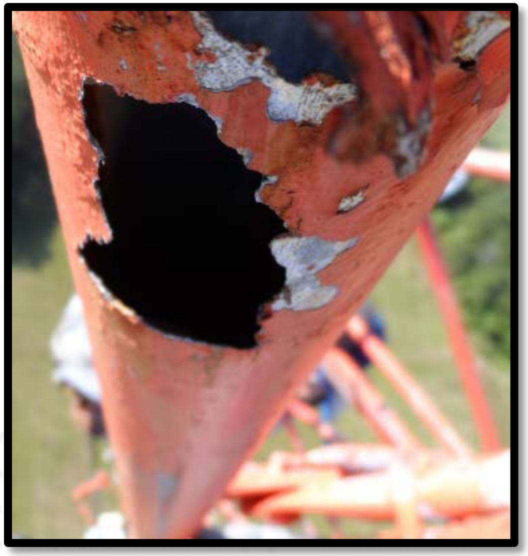
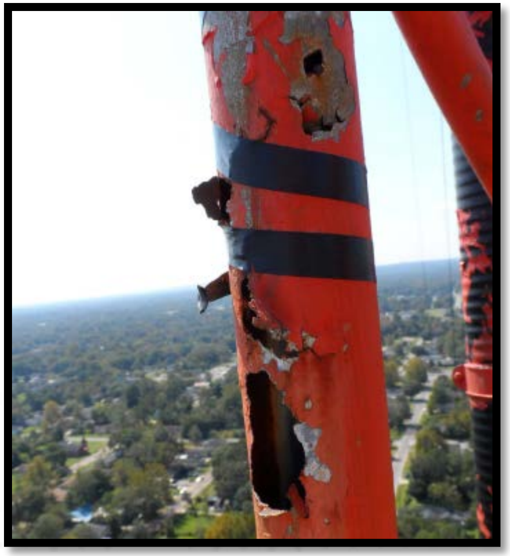
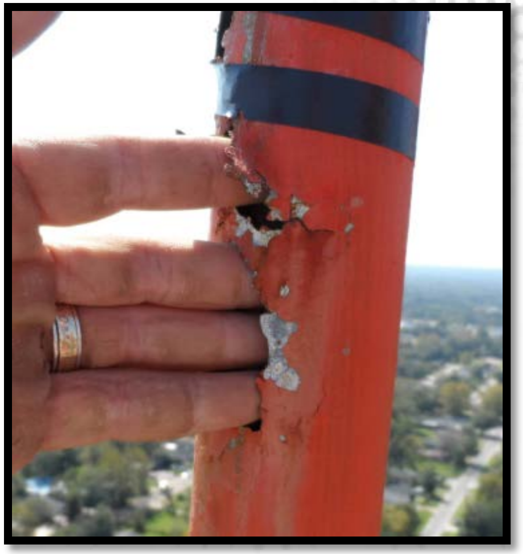
Inspection & Condition Assessment:







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Inspection Tools:

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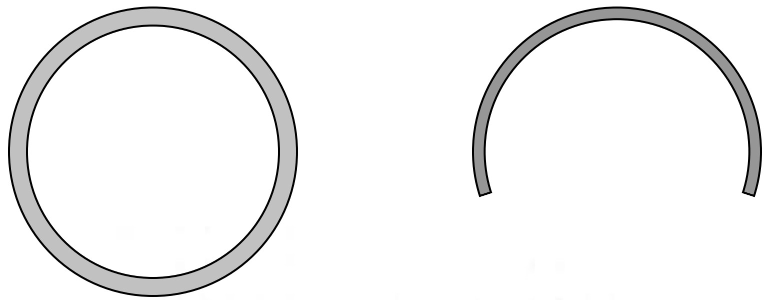
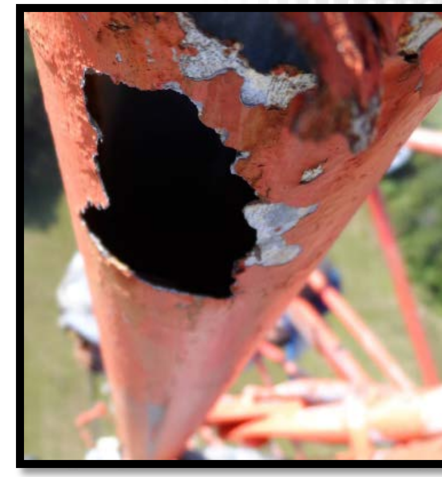
*Ultrasonic (UT) / FO Borescope:

*3 lb Sledge:

Deterioration Tower Analysis:

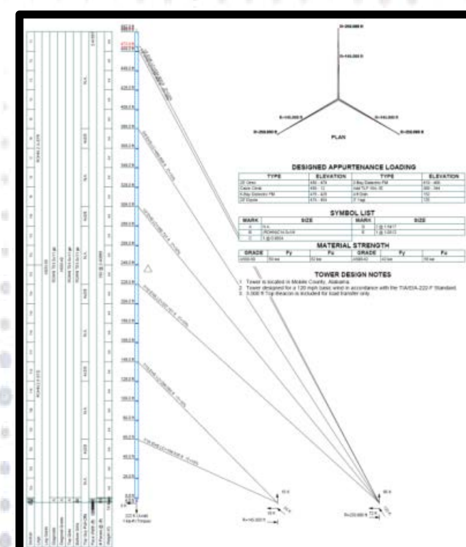
*Reduced Buckling Strength Calculated





Strength Reduced by Over 50%!!!

*Multiple Analyses Were Conducted to Determine Method for Dismantling



- First Choice ~ Light-Weight Gin Pole

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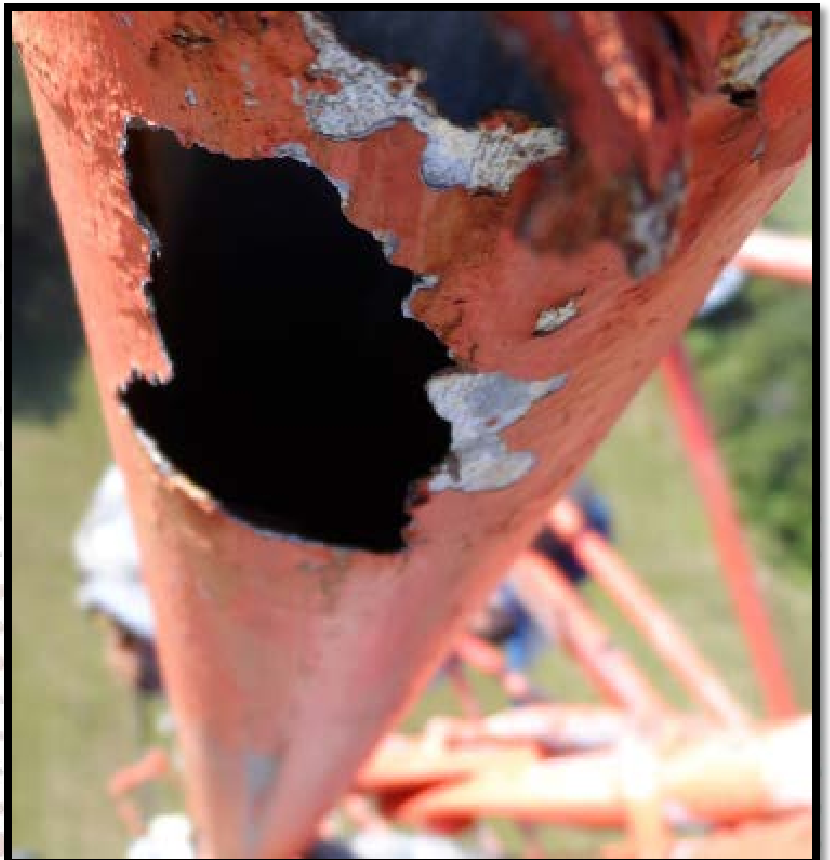
Dismantling Considerations (TIA-1019-A):

- Structure must be capable of safely resisting construction loads imposed by Rigging System during de-stacking operations (i.e. Gin Pole, Slings, Blocks, etc.)
- Rigged tower must be capable of withstanding minimum wind forces of 45 mph to 60 mph during non-operational times depending upon duration of de-construction period
  - MAJOR LOAD TO CONSIDER ~ Gin Pole

Controlled Demolition Selected:

Structure Could **NOT** Withstand the Minimum Construction Loads for Conventional De-Stack



tnxTower Electronics Research, Inc. 7777 Gardner Road Chandler, IN 47610 Phone: (812) 925-6000 FAX: (812) 925-4030	Job #30565 * ASRN 1059666	Page 1 of 14
	Project Prichard, AL (Mobile County)	Date 19:05:33 04/06/13
	Client Clear Channel	Designed by James Ruedlinger

Leg Interaction Design Data (Compression)

Section No.	Elevation ft	Size	Ratio $\frac{P}{P_a}$	Ratio $\frac{f_{bx}}{F_{bx}}$	Ratio $\frac{f_{by}}{F_{by}}$	Comb. Stress Ratio	Allow. Stress Ratio	Criteria
T1	489 - 469	PIPE 2 X-STR	0.375	0.000	0.000	0.375 ✓	1.000	H1-3 ✓
T2	469 - 449	PIPE 2 X-STR	0.509	0.000	0.000	0.509 ✓	1.000	H1-3 ✓
T3	449 - 429	PIPE 2 X-STR	0.519	0.000	0.000	0.519 ✓	1.000	H1-3 ✓
T4	429 - 409	PIPE 2 X-STR	0.484	0.000	0.000	0.484 ✓	1.000	H1-3 ✓
T5	409 - 389	PIPE 2 X-STR	0.521	0.000	0.000	0.521 ✓	1.000	H1-3 ✓
T6	389 - 369	PIPE 2 X-STR	0.551	0.000	0.000	0.551 ✓	1.000	H1-3 ✓
T7	369 - 349	PIPE 2 X-STR	0.640	0.000	0.000	0.640 ✓	1.000	H1-3 ✓
T8	349 - 329	PIPE 2 X-STR	0.639	0.000	0.000	0.639 ✓	1.000	H1-3 ✓
T9	329 - 309	PIPE 2 X-STR	1.328	0.000	0.000	1.328 ✗	1.000	H1-3 ✗
T10	309 - 289	PIPE 2 X-STR	0.690	0.000	0.000	0.690 ✓	1.000	H1-3 ✓
T11	289 - 269	PIPE 2 X-STR	0.677	0.000	0.000	0.677 ✓	1.000	H1-3 ✓
T12	269 - 249	PIPE 2 X-STR	0.678	0.000	0.000	0.678 ✓	1.000	H1-3 ✓
T13	249 - 229	PIPE 2.5 STD	0.601	0.000	0.000	0.601 ✓	1.000	H1-3 ✓
T14	229 - 209	PIPE 2.5 STD	0.616	0.000	0.000	0.616 ✓	1.000	H1-3 ✓
T15	209 - 189	PIPE 2.5 STD	0.580	0.000	0.000	0.580 ✓	1.000	H1-3 ✓
T16	189 - 169	PIPE 2.5 STD	0.581	0.000	0.000	0.581 ✓	1.000	H1-3 ✓
T17	169 - 149	PIPE 2.5 STD	0.665	0.000	0.000	0.665 ✓	1.000	H1-3 ✓
T18	149 - 129	PIPE 2.5 STD	0.676	0.000	0.000	0.676 ✓	1.000	H1-3 ✓
T19	129 - 109	PIPE 2.5 STD	0.650	0.000	0.000	0.650 ✓	1.000	H1-3 ✓
T20	109 - 89	PIPE 2.5 STD	0.651	0.000	0.000	0.651 ✓	1.000	H1-3 ✓
T21	89 - 69	PIPE 2.5 STD	0.725	0.000	0.000	0.725 ✓	1.000	H1-3 ✓
T22	69 - 49	PIPE 2.5 STD	0.739	0.000	0.000	0.739 ✓	1.000	H1-3 ✓
T23	49 - 29	PIPE 2.5 STD	0.693	0.000	0.000	0.693 ✓	1.000	H1-3 ✓
T24	29 - 9	PIPE 2.5 STD	0.701	0.000	0.000	0.701 ✓	1.000	H1-3 ✓
T25	9 - 8.1146	PIPE 2.5 STD	0.625	0.329	0.000	0.954 ✓	1.000	H1-3 ✓
T26	8.1146 - 6.5729	PIPE 2.5 STD	0.638	0.064	0.000	0.702 ✓	1.000	H1-3 ✓
T27	6.5729 - 5.0312	PIPE 2.5 STD	0.623	0.091	0.000	0.715 ✓	1.000	H1-3 ✓
T28	5.0312 - 4	PIPE 2.5 STD	0.624	0.124	0.000	0.748 ✓	1.000	H1-3 ✓

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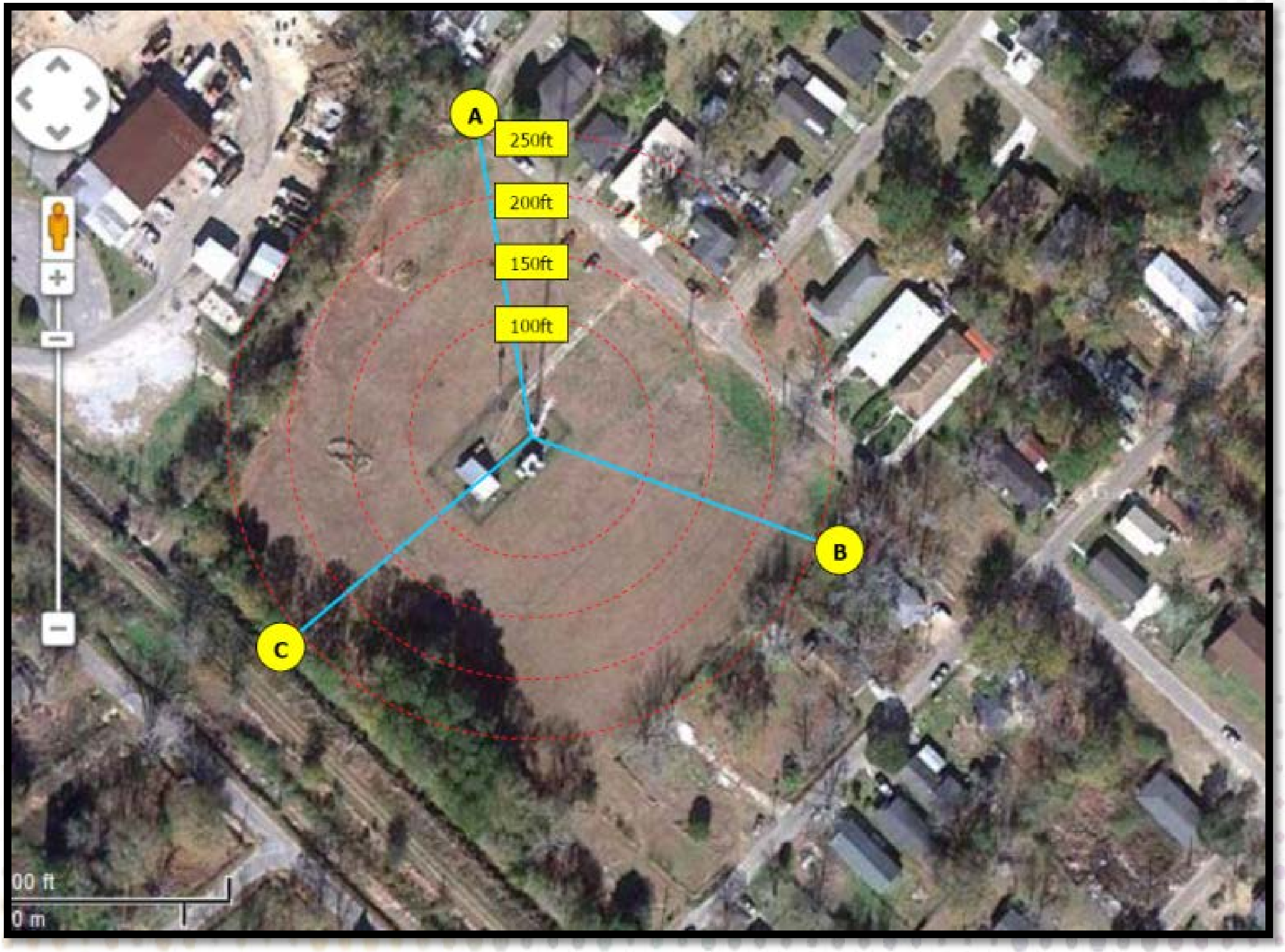
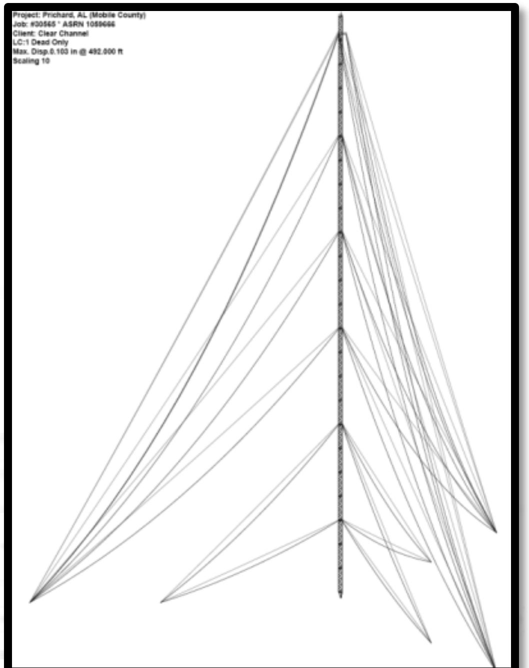
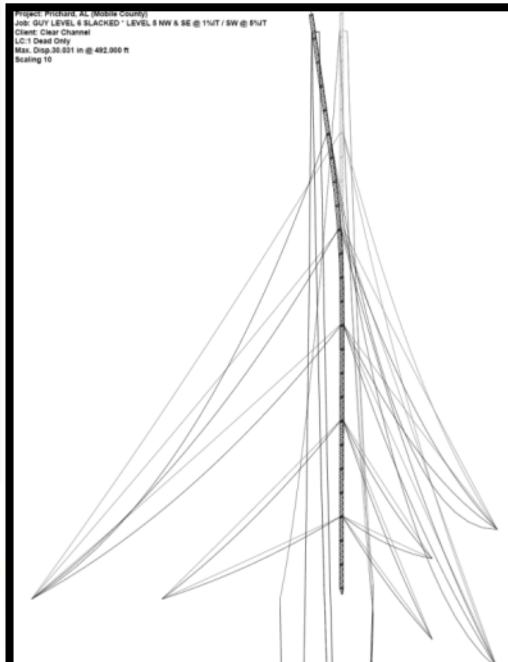
Due to Adjacent Homes, Roads, and Electrical Lines; **<u>Tower Had to Fall Within 150' Radius</u>**

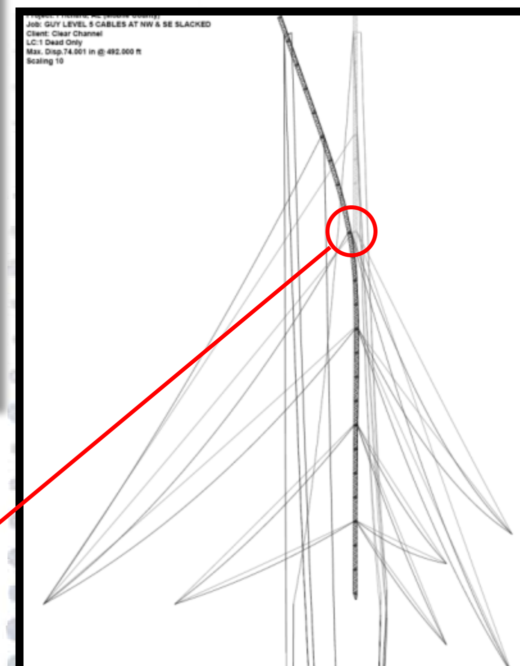


WARNING: Do Not Try This At Home!

Multiple Studies were Conducted to Determine Best and Most Reliable Fall Sequence







Location of Most Severe Corrosion Engineered to be First Yield Point
*Direct Fall of Top 180'

Relaxation & Removal of Pre-Determined Guy Cables in a Sequential Order Based Upon Results of Dismantle Analysis

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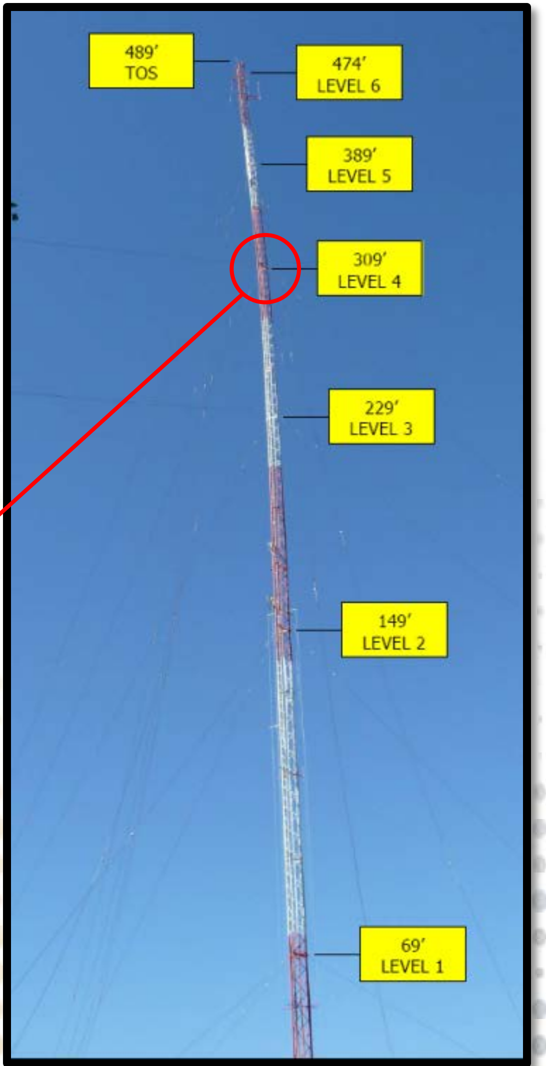
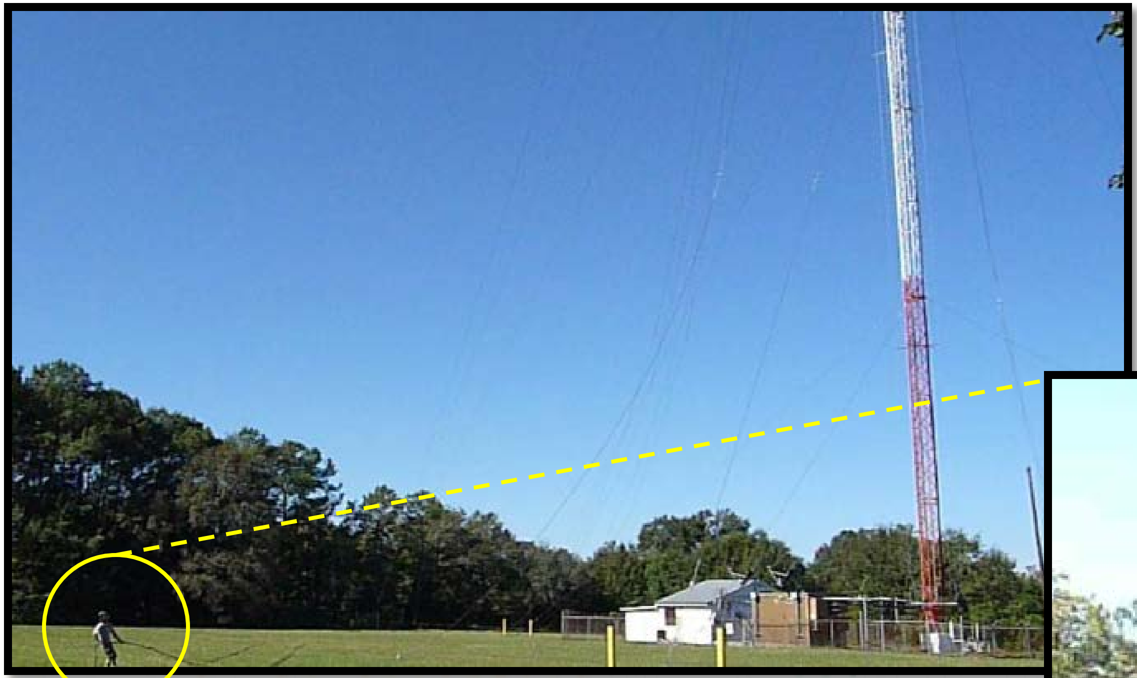
Severe Corrosion



Certain Guy Cables Were Disconnected From Anchors While Others Remained Intact Until The Critical Failure Point Was Reached



Initial Fall Sequence:

Matched Analysis Results

Secondary Collapse Mode:

Difficult To Predict!
Important to Control Initial Descent

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RESULTS:

*Tower Collapse Directed Towards SW Guy Path

*Fall Radius Limited to ~125’

Video Footage:

Special Concerns With Pipe/Tubing:

- Galvanizing:
  - If Pipe is NOT Properly and Uniformly Galvanized, Dramatic Loss of Material Can Occur in a Relatively Short Period Especially in Highly Corrosive Environments
  - Post-Galvanizing Welding Can Damage Internal Zinc Deposits at and Around Welding Area
- Adequate Ventilation/Drainage Holes:
  - Needed to Prevent Excessive Condensation
  - Allows Direct Drainage for Any Moisture Accumulation
- Thin Walled Sections:
  - Become Compromised With Relatively Small Amounts of Material Loss
  - Early Detection is Critical

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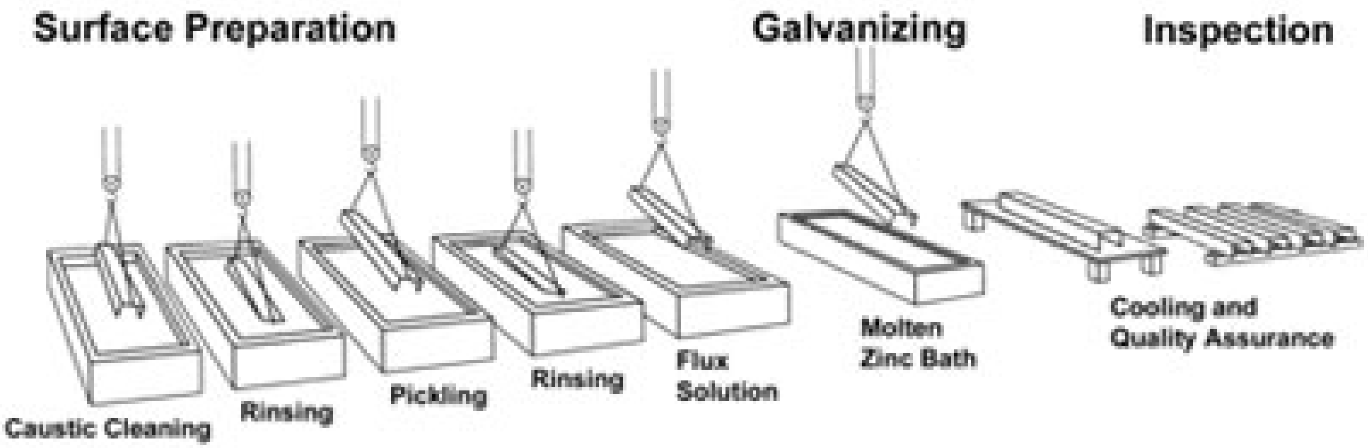
Galvanizing Process:

*Adequate Flow and Drainage is Crucial in Uniform Coatings



Galvanizing Issues:

*Recessed Design ~ Good Drainage

*Butt Design ~ Poor Drainage

*Pickling Acid Does Not Fully Drain Which Can Result in Poorly Coated Areas

Galvanizing Issues:

Galvanizing **NOT** Uniformly Deposited on Internal Portions of Pipe

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Adequate Ventilation/Drainage Holes:

*Ventilation ~ Ensure Pipe’s Interior Environment Adjusts Quickly With External Changes in Temperature, Relative Humidity, and Atmospheric Pressure to Prevent Excessive Condensation

*Drainage ~ Ensure Any Accumulated Moisture May Easily Flow Out of Pipe

“Weep Hole”

Adequate Ventilation/Drainage Holes:

*Freeze/Thaw Damage

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Thin Walled Sections:

*Relatively Small Amounts of Material Loss Can Be Critical to Member's Load Carrying Capability As Compared to Solid Steel Sections

Aging Broadcast Infrastructure:

- Thousands of Pipe/Tube Structures Well Over 20 Years Old Currently In Service
- Ongoing Maintenance Inspections By Qualified Personnel Are Critical To Extending Serviceable Life As Well As Determining When To Safely Decommission Tower
  - Guyed Towers ~ Conduct Thorough Inspection At Least Every 3 Years
  - Self Support Towers ~ Conduct Thorough Inspection At Least Every 5 Years
  - If Site Specific Issues Exist (Such as Corrosion), Inspection Frequency Should Be Increased

Bonus Footage

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Questions?

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