



2015 Ohio Bridge Conference



AZZ Galvanizing Services

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The Corrosion Problem



**25-30% could be eliminated
if adequate corrosion protection
systems were employed**



We Prote

Guide Rail



The Corrosion Problem



Tour of the City







Age to Canada 1/4 mi
Clark Ave 1
Illinois Ave 1 3/4

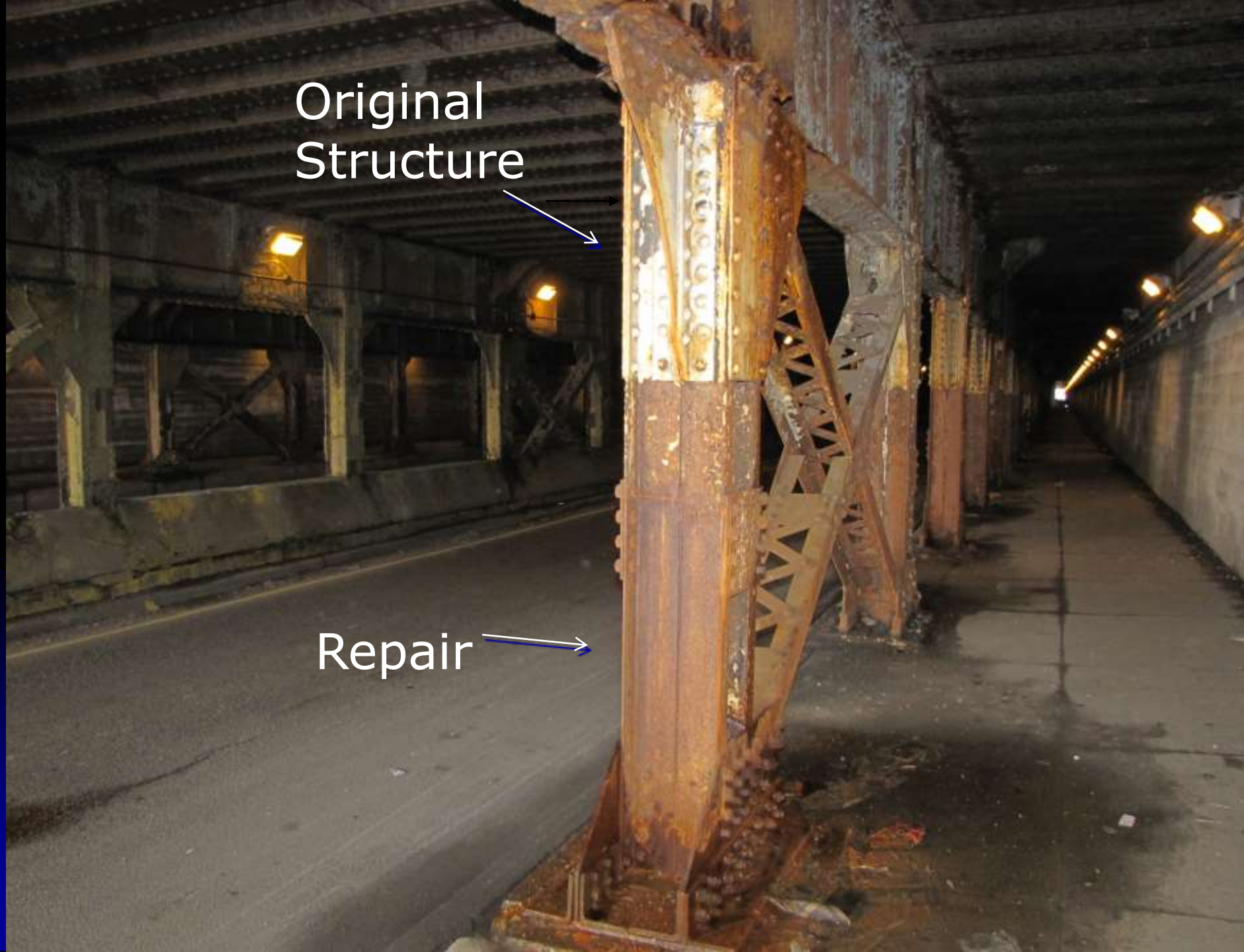






Original
Structure

Repair















Ford County – 00N, 2350E







Corrosion Protection

I69 over East 82nd Street,
Castleton, IN



I-69 Bridge





6.20 6.10 7.60
8.90 7.70

7.60 8.00 5.70
5.50 7.40

$\bar{X}=6.82$

7.60 7.70 6.70
5.80 5.60

6.20 6.10 7.60
8.90 7.70

7.50 7.50 6.60
7.30 5.60

Beam 1

CTA , IL Toll Road, IDOT &
Counties

Over 72 Million Pounds of
Bridges were Galvanized in
Illinois in last 5 years.



26th Street & the Dan Ryan





MUSKINGUM COUNTY ENGINEER'S OFFICE ZANESVILLE, OHIO



BOGGS ROAD BRIDGE REPLACEMENT STEEL VS. CONCRETE

Material Costs Steel:

1. Bolt Together Steel Structure	\$26,016
2. Decking (1.5C – 18 ga. Decking)	\$2,223
3. Shear Studs	\$1,680
4. Bridge Railing and Guard Rail	\$14,590
5. Reinforcing Steel	\$7,490
6. Concrete /Forms (180.5 CYs)	\$27,026
7. Asphalt Repair	<u>\$11,500</u>
Subtotal	\$90,524

Labor and Equipment Costs:

1. Labor (21 days)	\$19,562
2. Equipment	<u>\$21,679</u>
Grand Total	= \$131,765

Material Costs Concrete:

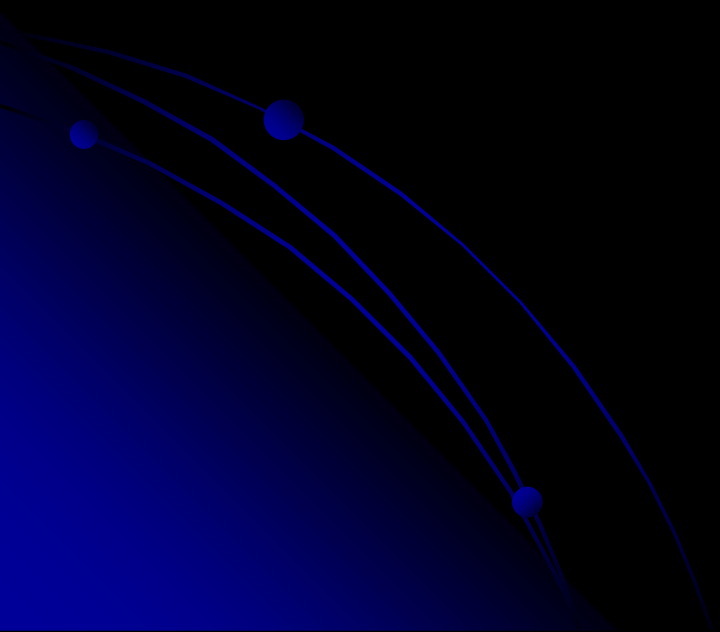
1. Concrete Box Beams (6 Beams)	\$59,400
2. Bridge Railing and Guard Rail	\$11,500
3. Reinforcing Steel	\$5,000
4. Concrete/Forms (160 CYs)	\$24,000
5. Asphalt Repair	\$11,500
6. Crane Rental	<u>\$2,500</u>
Subtotal	\$113,900

Labor and Equipment Costs:

1. Labor (18 days)	\$14,757
2. Equipment	<u>\$21,679</u>
Grand Total	= \$150,336

Difference Between HDG Steel Beams and Concrete Box
Beams ~ **\$18,571**

Corrosion Process



Law of Entropy

- Tendency for metal, after production and shaping, to revert back to its lower, more natural energy state or ore

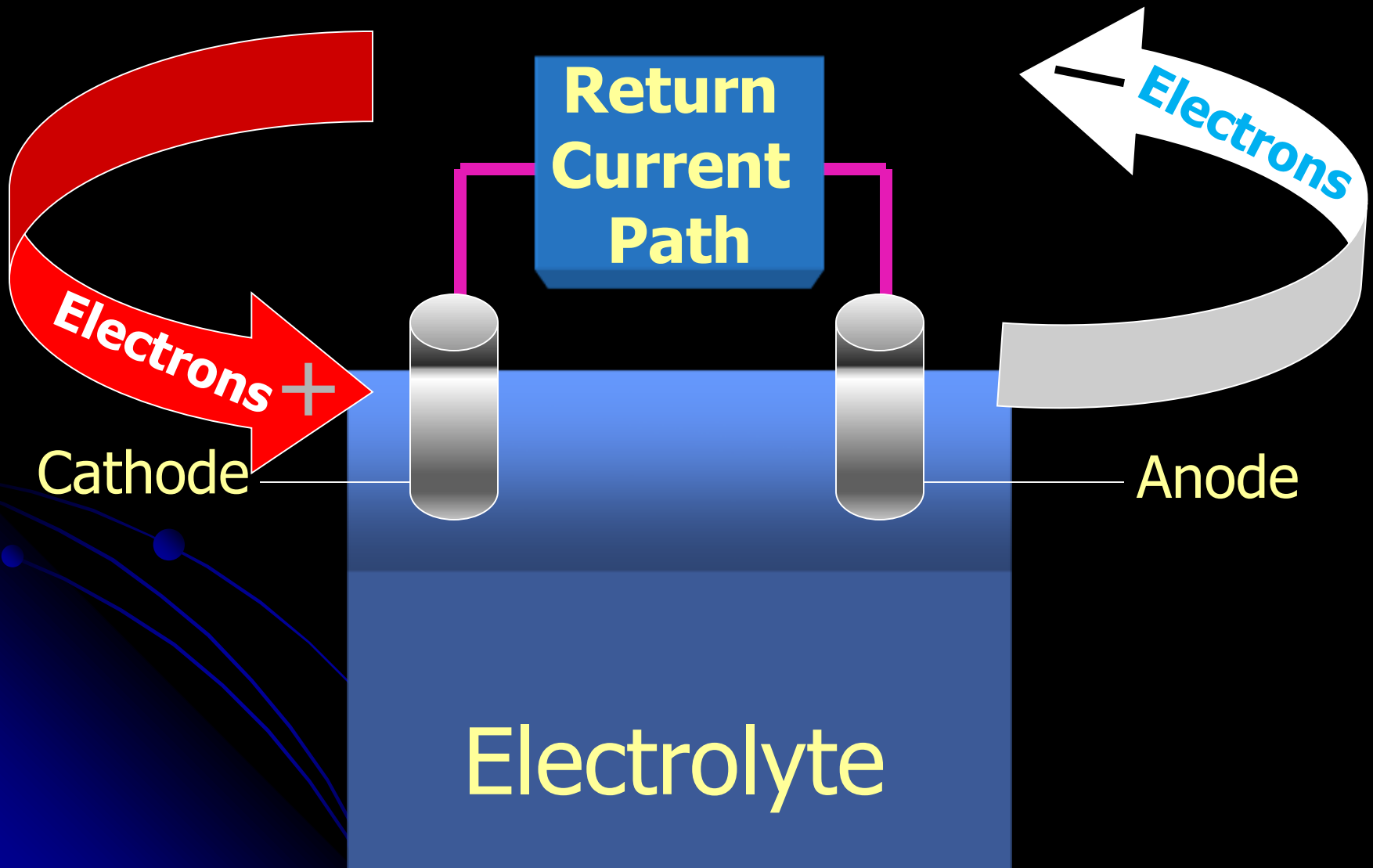


Definition of Corrosion

- *Corrosion (n)*: the chemical or electrochemical reaction between a material and its environment that produces a deterioration of the material and its properties



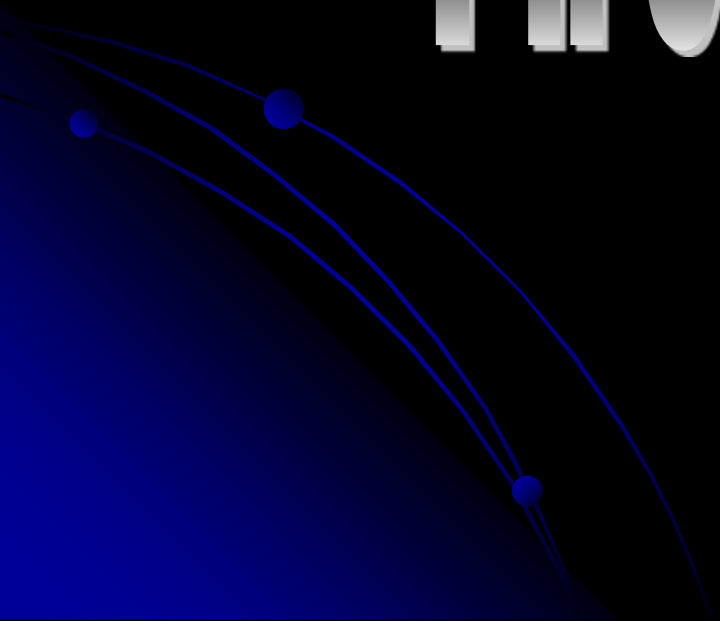
Bimetallic Couple



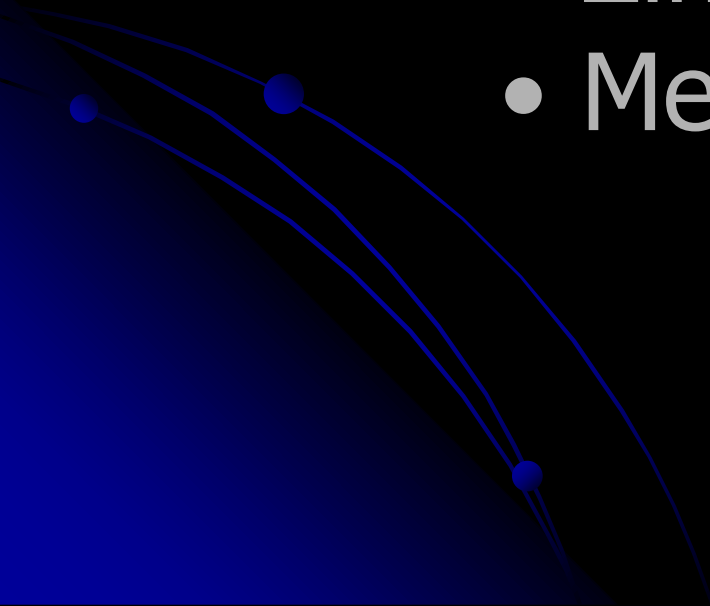
GALVANIZED POLE ON PAINTED PLAIN CARBON STEEL BASE



The Solution



Long-Lasting Zinc Protection

- Barrier
 - Cathodic
 - Zinc Patina
 - Metallurgical Bond
- 



Barrier Protection

Cathodic Protection

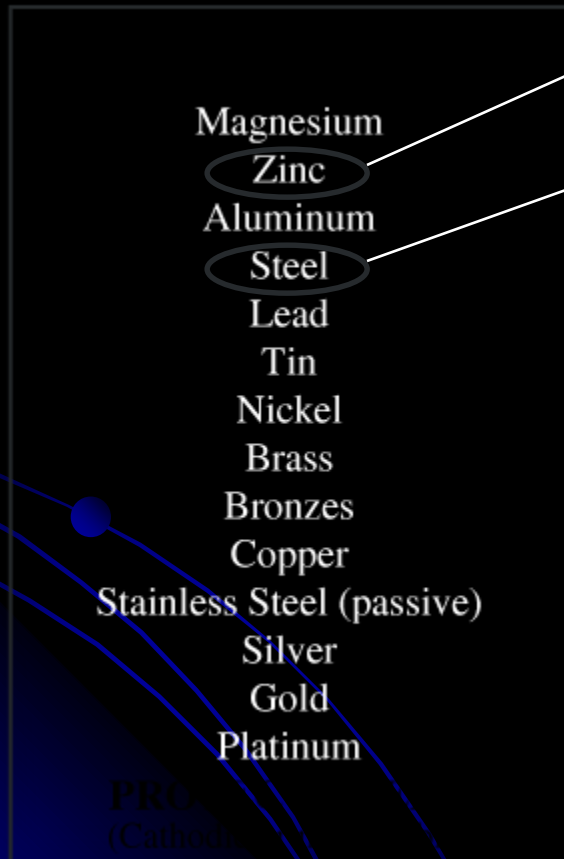
Zinc



Galvanic Series of Metals

ZINC = ANODE

STEEL = CATHODE



This arrangement of metals determines what metal will be the anode and cathode when the two are put in a electrolytic cell (arrangement dependent on salt water as electrolyte).

Sacrificial Zinc Anodes



Zinc Patina

Zinc Carbonate

Zinc Hydroxide

Zinc Oxide

Zinc

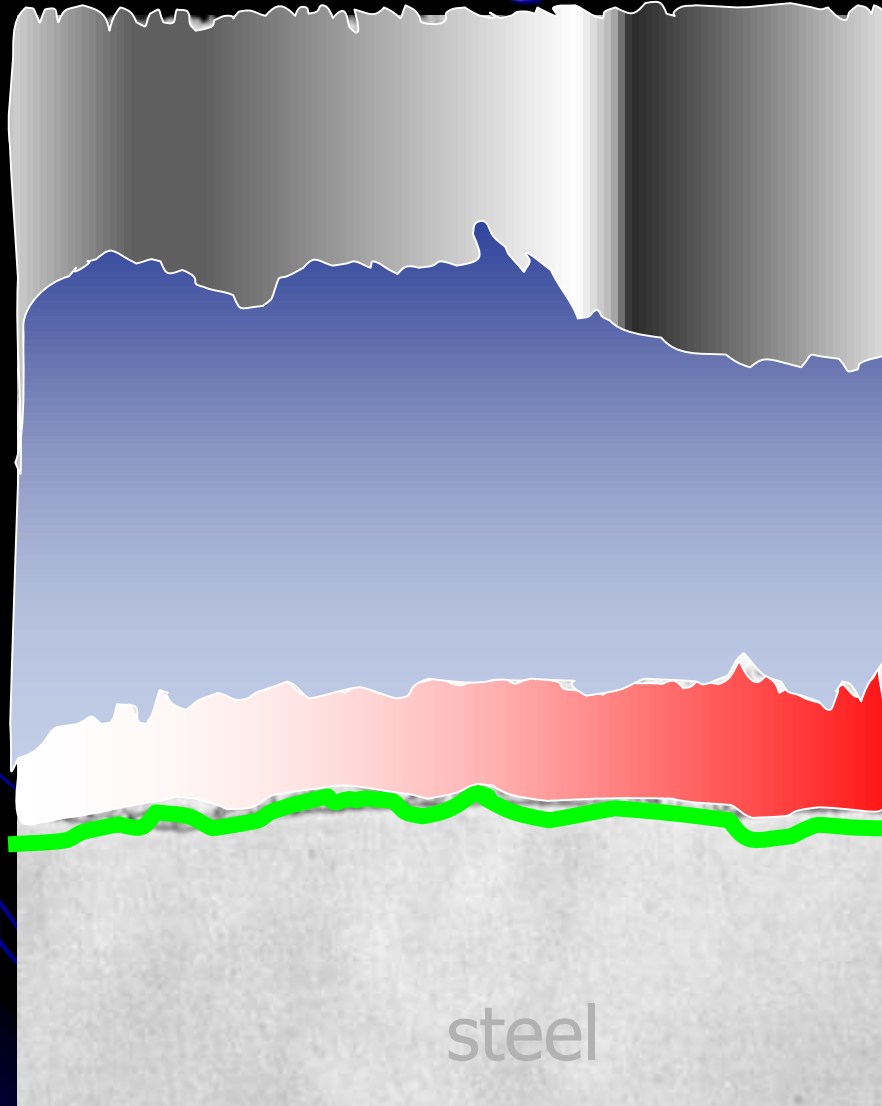
Metallurgical Bond

Eta

Zeta

Delta

Gamma



100%

Zinc

94% Zinc

6% Iron

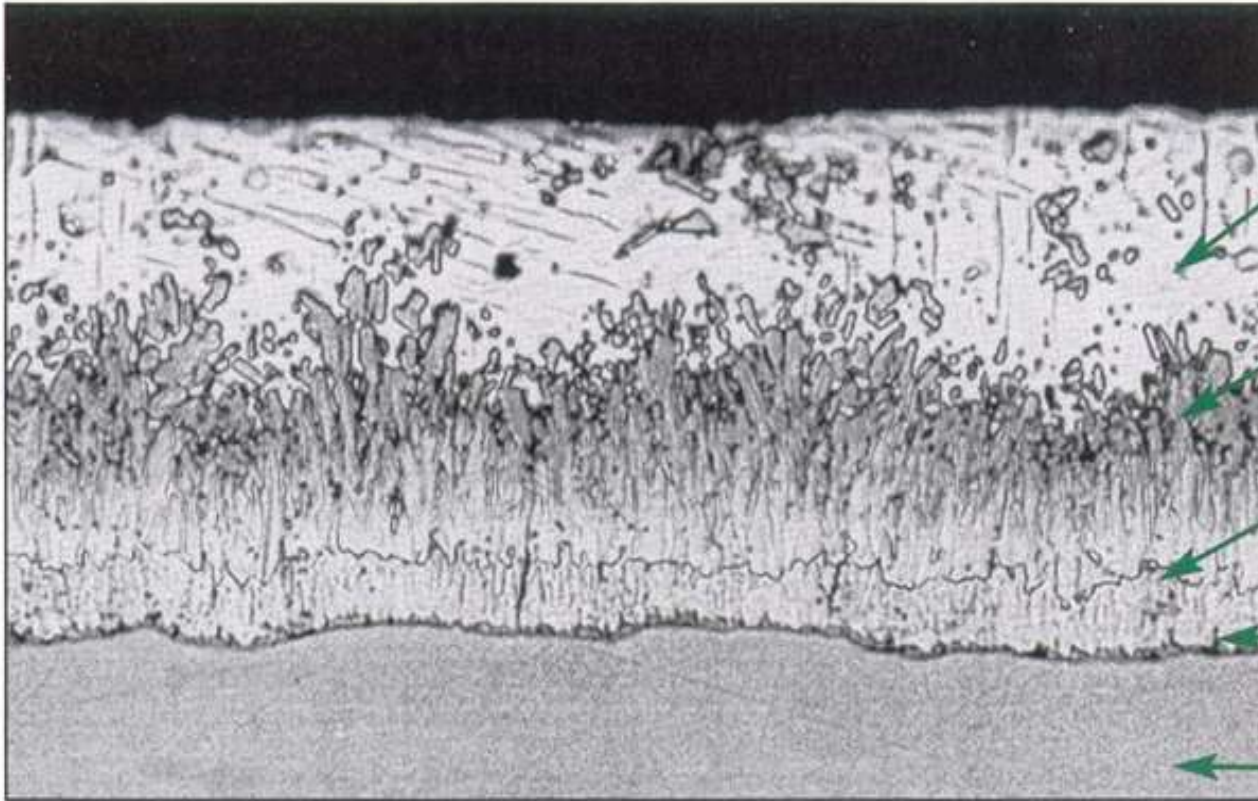
90% Zinc

10% Iron

75% Zinc

25% Iron

Metallurgical Bond



Eta

(100% Zn)

70 DPN Hardness

Zeta

(94% Zn 6% Fe)

179 DPN Hardness

Delta

(90% Zn 10% Fe)

244 DPN Hardness

Gamma

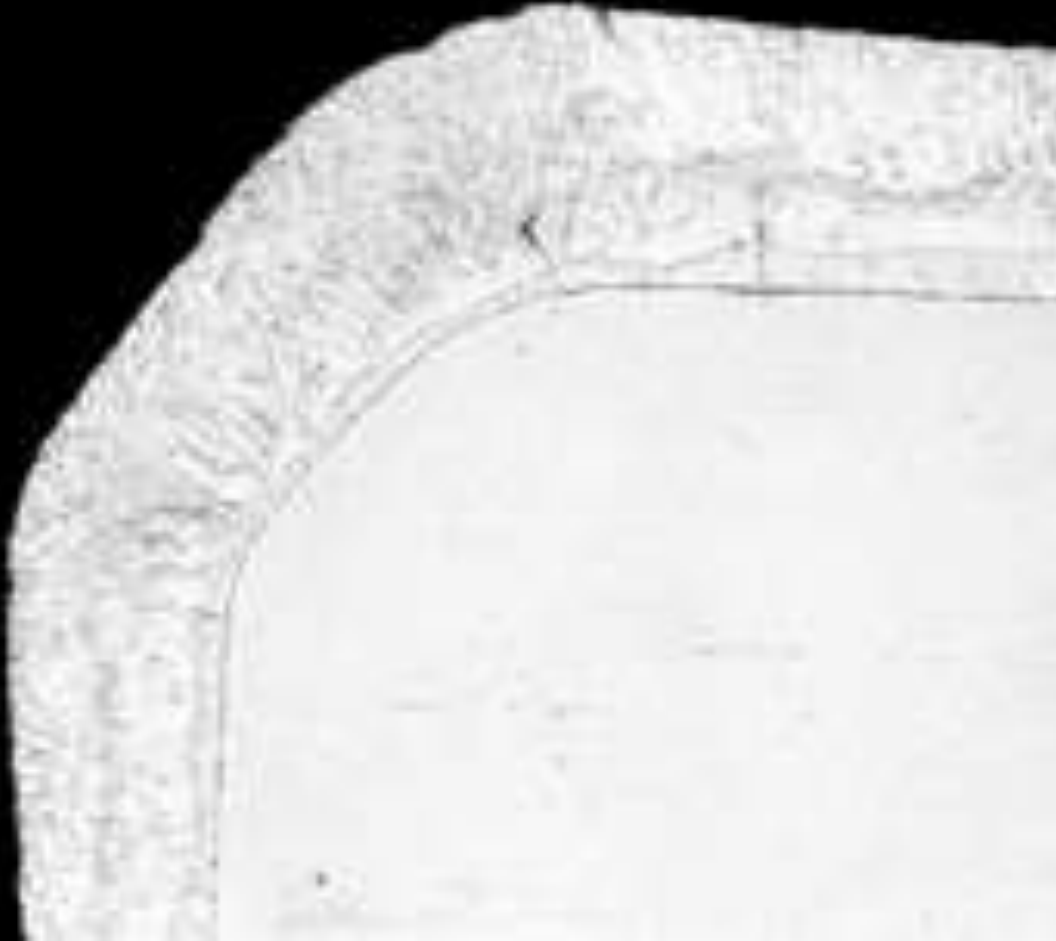
(75% Zn 25% Fe)

250 DPN Hardness

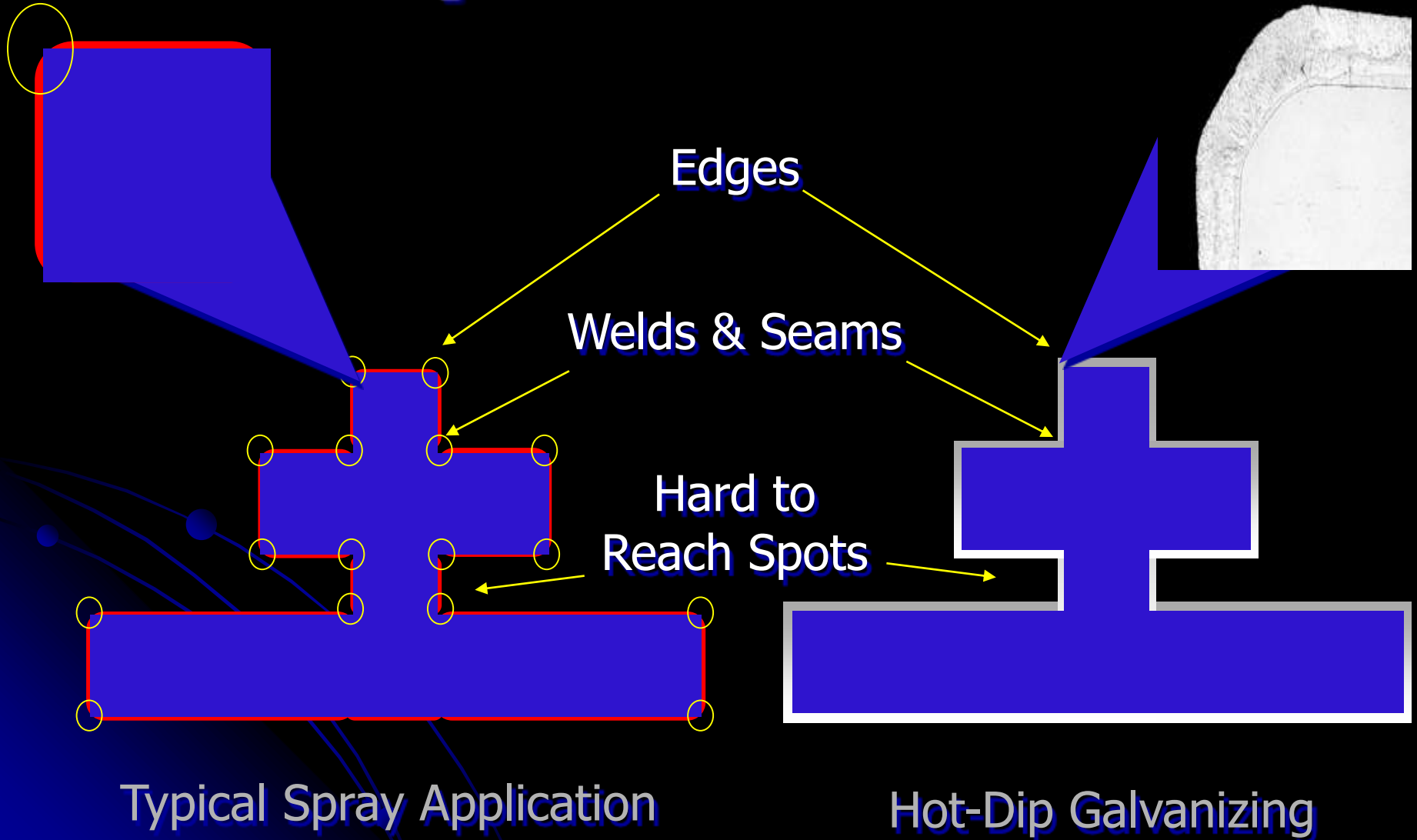
Base Steel

159 DPN Hardness

Edge Protection



Complete Protection



Galvanizing Process



HDG Process: Surface Preparation

- Thorough cleaning is necessary as zinc will only adhere to clean steel
 - **Degreasing** – removes dirt, oils, organic residue



**Degreasing
Tank**