

Newman Road Reconstruction and KBS Railroad Bridge Slide: Design, Construction & Lessons Learned



ABCD Central Ohio
Webinar Series

July 20, 2021

Presentation Overview

- Introduction
- Project Team and Funding
- Major Project Scope
- Design and Construction Challenges
- Bridge Construction
- Lessons Learned
- Q&A Session

Introduction

- **Robert Anderson, P.E., S.E.**



Project Manager (ASI)
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- **Adam Dahlfors, P.E.**

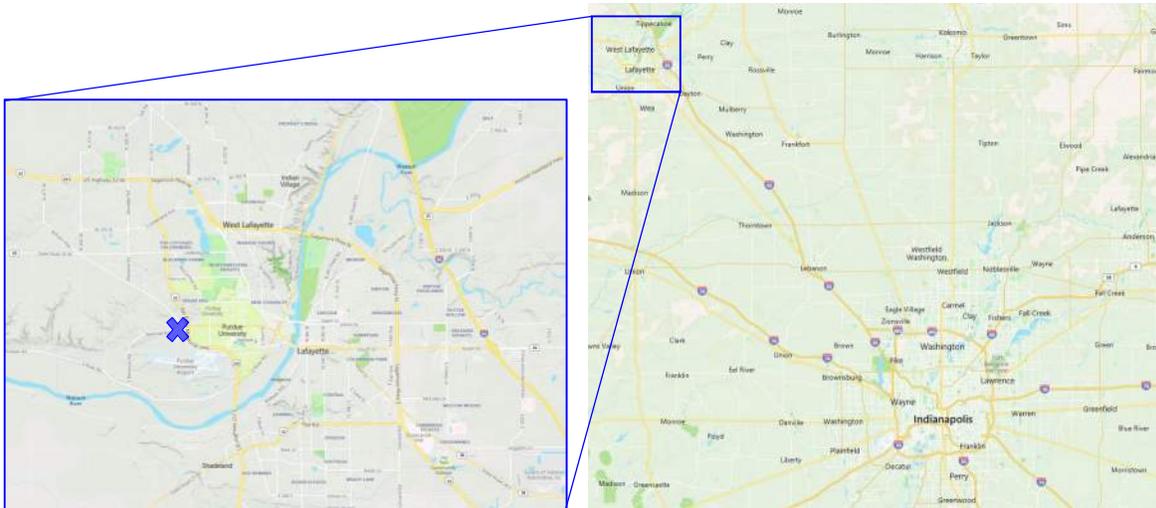


Project Engineer (ASI)
adahlfors@structurepoint.com

Project Background

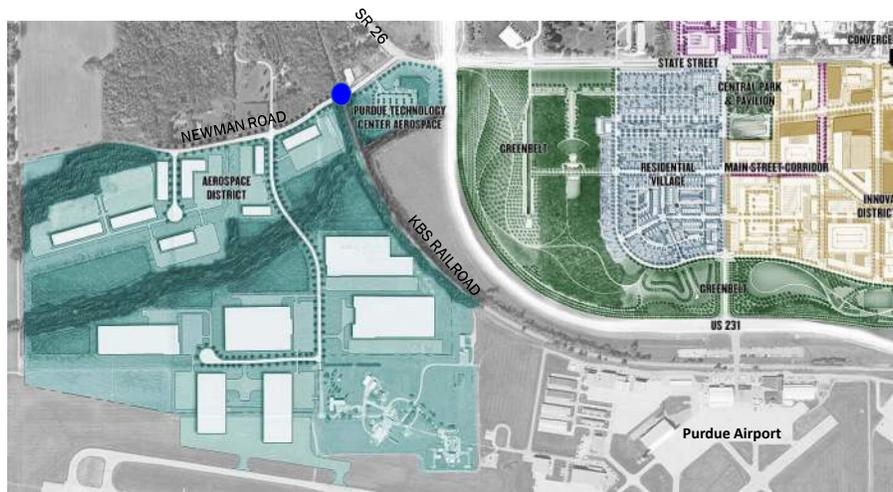
- **Creation of Purdue Discovery Park District Aerospace**
 - Being Developed by Purdue Research Foundation
 - 176-acre site situated southwest corner of Purdue University
 - Advance Aviation and Aeronautics Innovations
 - Indiana Certified Technology Park
 - Driving Economic Development of Greater Lafayette Area
 - Create up to 3,500 jobs

Location Map



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Location Map



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Project Background

- **Inadequate Access to District Aerospace**
 - Improve safety and traffic operation for future growth
- **Substandard Existing Infrastructure**
- **Active Railroad Bridge**
 - Low vertical clearance
- **Newman Road**
 - One lane road under RR bridge
 - Substandard curve



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Project Team and Funding

- **Project announced by Purdue, West Lafayette and Purdue Research Foundation (PRF) in April 2019**
 - Joint local public agency roadway improvement project
 - Design-bid-build delivery method
- **Funding Source: Purdue, City of West Lafayette, PRF and INDOT**
 - \$10 million through Federal Funds Exchange Program
 - \$2.5 million match by PRF
- **Designer: American Structurepoint, Inc**
- **Contractor: ICC Group**

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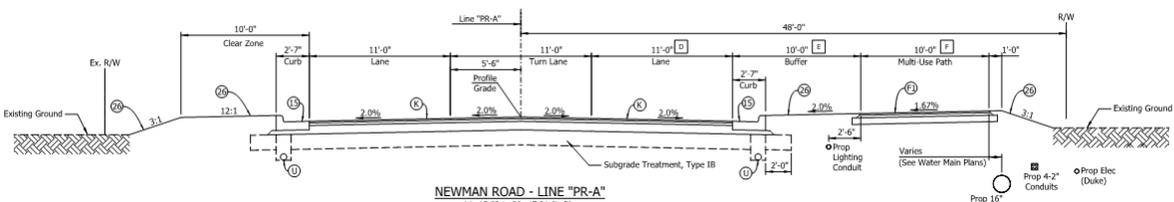
Major Project Scope

- Newman Road Reconstruction
- State Road 26 Intersection Reconstruction
- Allison Road Intersection Construction
- KBS Railroad Bridge Replacement
- Water Main Construction

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Newman Road Reconstruction

- From just west of Benson Drive to the intersection of State Road 26 and Newman Road
- Length is approximately 0.3 miles
- Typical Section:
 - 3 - 11' lane with curb and gutter; 2 - westbound lanes and 1 - eastbound lane
 - Grass strip and 10' multi-use path on south side



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State Road 26 Intersection Reconstruction

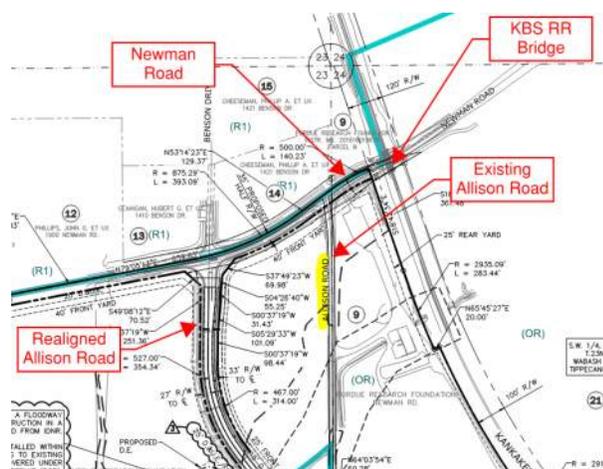
- Converted an existing T-intersection into a multi-lane roundabout
- Accommodate future District Aerospace development



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Allison Road Intersection Construction

- Realigned an interior roadway (Allison) within the District Aerospace
- Created a new four legged intersection
- Coordinated with adjacent project



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KBS Railroad Bridge Replacement

Project Summary:

- Remove Existing Stone Arch Structure
- Replace with Welded Steel TPG Bridge
- Approx. 450,000 lb. A709 Gr. 50W Steel
- One Span: 120'-0" Square Bridge
- Girder Depth is 96" Deep (Web)
- Bridge on 1.30% Tangent Grade



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KBS Railroad Bridge Replacement

Basics of Railroad Bridge Design

- Steel design per Allowable Stress Design (ASD) [AREMA Ch. 15]
- E80 design Live Load >> Design Dead Load
- Impact load of 30% or more typ.
 - Rocking Effect
- Often deflection-controlled for large spans
 - L/640 typ.
- Check fatigue stress range
- Large longitudinal (traction/braking) forces

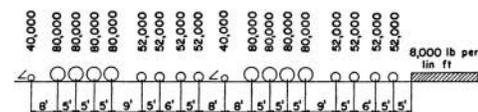
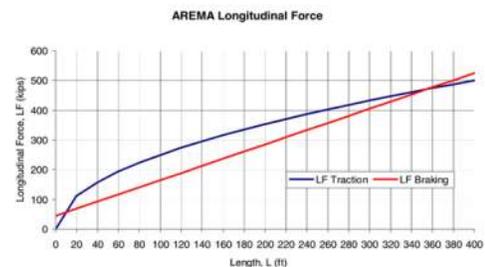


Figure 15-1-2. Cooper E 80 Load



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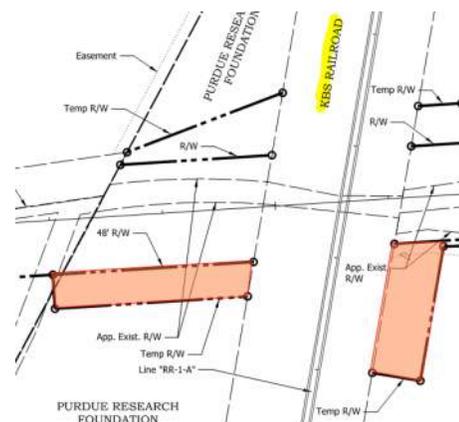
KBS Railroad Bridge Replacement



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KBS Railroad Bridge Replacement

- **Construction Requirements**
 - Steel Superstructure Shop Drawing Submittal (critical path item)
 - Train Schedule & Track Closures
 - 2 Trains per day @ 10 mph typ.
 - Weekdays only (No weekend services)
 - One 106-hour Closure for Bridge Change-Out
 - Additional weekend track closures (and short weekday outages) also available by request
 - Areas provided for bridge laydown & erection
 - Slide or Picking Methods allowed
 - Track monitoring requirements



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Design and Construction Challenges

- **Commitments to District Aerospace**
 - Saab Defense and Security US manufacturing facility
 - Aggressive Project Schedule
 - Water Supply
- **Safety for Traveling Public and Construction Workers**
- **Major Environmental and Drainage Concerns**
- **Major Utility Relocations**
- **Access to Purdue Technology Center Aerospace**
- **Steel Fabrication**
- **Bridge Construction & Slide**

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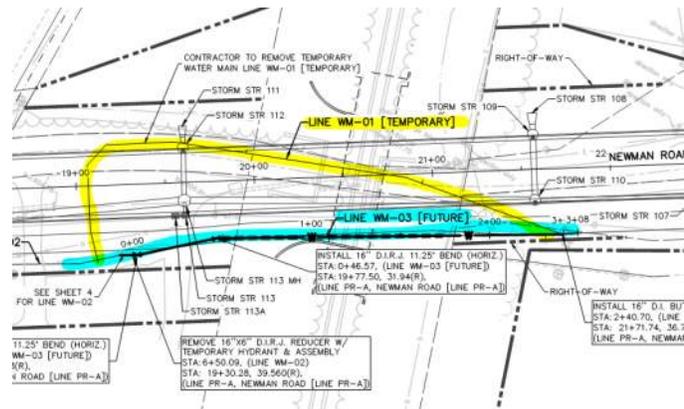
Aggressive Project Schedule

- Oct 2018 to March 2019 – Phase 1 (Study)
- April 2019 to Nov 2019 – Phase 2 (Design)
- 11/6/19 – Pre-bid Informational Meeting
- 11/26/19 – Request for bids
- 12/17/19 – Bid Opening
- 12/20/19– Notice to Proceed
- Feb 2020 to April 2020 – Major Utility Relocations
- 2/17/20 to 3/27/20 – Shop Drawings Review & Approval
- 5/1/20 – Temporary Water Main Completion
- April 2020 to July 2020 – Steel Fabrication
- August 2020 – Bridge Change-out/Slide
- 11/13/20 – Substantial Completion (Newman Road open to traffic)

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Water Supply

- Water Main Construction
- 16" temporary water main to feed Saab facility by 5/1/20
- 16" permanent water main constructed after existing arch structure was removed



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Safety for Traveling Public and Construction Workers

- Newman Road Closure
 - Closed when utilities started relocations and reopened after bridge slide
 - Provided flexibility for contractor
- State Road 26 Closure
 - Allowed 45 days for roundabout construction
 - Provided a better product
- Additional Coordination
 - Emergency departments
 - School district and USPS
 - Local businesses and residents

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Major Environmental and Drainage Concerns

- Cluster of Elm Trees
- Located on the SE Quad of RR Bridge
- One of the oldest and tallest in the State of Indiana
- Survived the Dutch Elm disease (DED) in 1920's
- Limited Slide Direction



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Major Environmental and Drainage Concerns

- Widening of Newman Road
 - Additional impervious areas need to be detained to meet County ordinances
- Coordination with PRF and District Aerospace to Use Same Detention Pond
 - Eliminated need to find additional location



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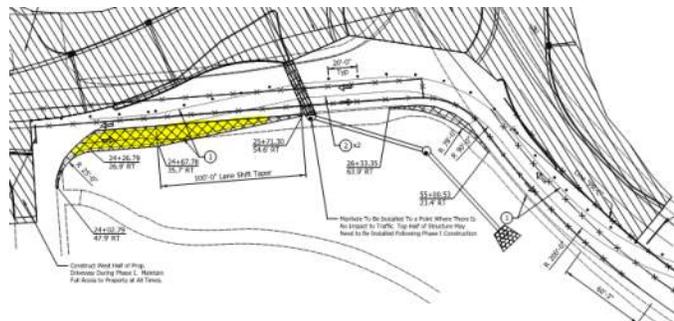
Major Utility Relocation

- **MCI – Verizon**
 - Existing fiber running along railroad ballast (west side)
 - Relocated underground (west side along RR right-of-way)
 - Required railroad permitting
 - Relocation completed on 4/19/20; ICC started construction on 4/20/20
- **Duke Energy**
 - Existing poles along south side of Newman Road
 - Multi-phase relocations (3)
 - (1) Within RR Right-of-Way; (2) SR 26; (3) Remaining Newman Road
 - Relocated underground along south side of Newman Road

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Access to Purdue Technology Center Aerospace

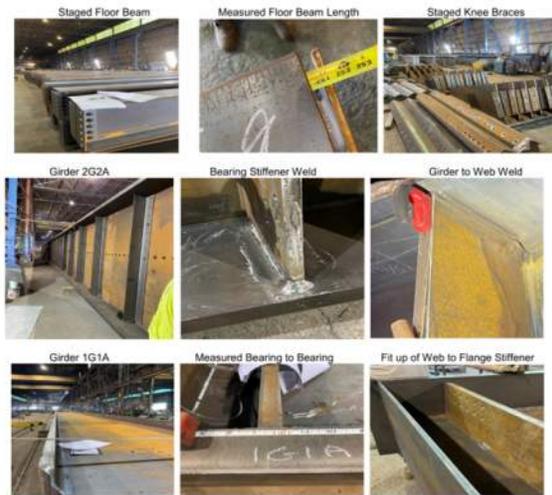
- **Adjacent to Project Site**
- **Semi Truck Delivery**
 - Supplies
 - Fuel
 - Nitrogen
- **MOT Phases**
 - Allow two-way traffic



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Steel Fabrication

- Advance Communication with NSBA
 - Lead Time (6-8+ mo.) and Approx. Rolling Schedules
 - Current Price Info
- Pre-Bid Meeting
 - Input from Fabricators & Contractors
 - Change in girder web-to-flange welds: CJP to fillet
- Shop Drawing Review & Approval
 - 1st Submittal: 2/17/20, Revise & Resubmit: 3/3/20
 - 2nd Submittal: 3/24/20, Approved: 3/27/20
- Fabrication: April 2020 to July 2020
 - Delays from April storm damage & COVID-related absences
 - 3rd Party inspections & testing
- Delivery: July 2020



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Bridge Construction

- Pile Driving (May 2020)
 - Template for battered piles
 - Pile splices
 - Dynamic Test Pile
 - Failure & Redesign



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Bridge Construction

- Pile Driving (May 2020)



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Bridge Construction

- Steel Girder Delivery and Erection (July 17, 2020)
 - 250t mobile crane with 215,000 lb. counterweight
 - 112k max. girder weight & FS = 1.5 for required pick radius



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Bridge Construction

- Steel Girder Delivery and Erection (July 17, 2020)



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Bridge Construction

- Steel Bridge Erection & Assembly
 - July–Aug. 2020



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Bridge Construction

• Main Outage – Day 3 (August 28, 2020)

	Friday, 8/28																
Newman Rd Underpass Project	4A	5A	6A	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P
LOCATION / ACTIVITY	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57
Place CLSM				X	X	X	X	X	X								
Install Drainage/Back fill (partial)						X	X	X	X	X	X						
Temp Shoring																	
Cut Piles to grade & align	X	X	X	X	X	X											
Set & Connect Cap Beams				X	X	X	X	X	X	X	X	X	X	X	X	X	X
Install Slide Plates						X	X	X	X	X	X	X	X	X	X	X	X
Excavate & Grade Slopes (N & S)	X	X	X														
Place Rip Rap (partial) (N & S)	X	X															
Bridge Slide																	
Set Bearings								X	X	X	X						



Bridge Construction

• Main Outage – Day 4 (August 29, 2020)

	Saturday, 8/29																			
Newman Rd Underpass Project	4A	5A	6A	7A	8A	9A	10A	11A	12P	1P	2P	3P	4P	5P	6P	7P	8P	10T	11T	
LOCATION / ACTIVITY	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84
Bridge Slide																				
Set Bearings																				
Prepare for Slide	X	X																		
Slide Bridge to Bearings			X	X																
Jack Bridge					X	X														
Remove Temp Shoring Cap Beams					X	X	X													
Lower Bridge onto Bearings					X	X	X													
Set & Connect West Wingwalls					X	X														
Install and Epoxy Anchor Bolts					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Post Bridge Slide																				
Set & Weld Backwall Cover Plates					X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Complete Waterproofing at Ends															X	X	X	X	X	X
Connect Bridge Drainage System															X	X	X	X	X	X
Backfill End Berms															X	X	X	X	X	X



Bridge Construction

- Main Outage – Day 4 (August 29, 2020)



Bridge Construction

- Main Outage – Day 5 (August 30, 2020)

	Sunday - 8/30																	
LOCATION / ACTIVITY	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
Newman Rd Underpass Project	4A	5A	6A	7A	8A	9A	10A	11A	12A	1P	2P	3P	4P	5P	6P	7P	8P	9P
Backfill End Bents	X	X	X															
Railroad Work																		
Place and Grade Subballast				X	X	X	X	X	X									
Place Precast Blocks on Bridge							X	X	X									
Place Ballast & Construct Track								X	X	X	X	X	X	X	X	X	X	X
Grade and Line New Track																	X	X



Bridge Construction

- Track Re-Opened: 8/31/2020



Road Construction



Completed Project Photos (Drone)



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Completed Project Photos (Drone)



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Completed Project Video (Drone)



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Lessons Learned

- **Battered Piles**
 - vs. Additional Plumb Piles
- **Time-consuming Welding**
 - Overhead pile-to-pile cap connection
 - Deck plate to floorbeam connection
 - Grinding galvanized coating



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Lessons Learned

- Realistic Construction Tolerances
 - Pile driving tolerances
 - Precast cap and backwall
 - Erection/crane placement



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Lessons Learned

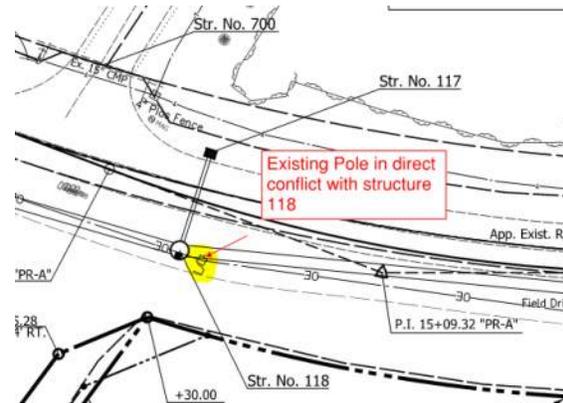
- Coordination with Major Utility Companies
 - Partnership; Frequent communication; Provided continued support
- Construction Staking for Utility Relocations
 - Met on site to determine what was needed



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Lessons Learned

- Temporary Roundabout Lighting
 - Roundabout opened to traffic vs light poles installation
- Earthwork Balance
 - Sequence of operation
- Proposed Manhole Conflict
 - Phase 3 Duke relocation contingent on Allison Project



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Acknowledgements

- Purdue University
- West Lafayette
- Purdue Research Foundation
- Kankakee, Beaverville & Southern (KBS) Railroad
- INDOT
- ICC Group
- American Structurepoint



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Q&A Session



<https://youtu.be/o4PICX6QetM>
<https://youtu.be/IRKnYERBumE>