Innovations in Infrastructure

Purpose

To provide an update of some of the innovations going on behind the scenes which are utilizing data to move BART further away from reactive problem solving and toward predictive actions and solutions.

Construction *Engineering* *Maintenance*

PG&E Outage – October 2019

BART, a beacon of light during the power outages

Direct Fixation Fasteners – Old vs New

Construction

Original DF Fastener

- Bolts Break and Strip
- Pads crack and cause noise
- $ Higher Lifecycle Costs
- Deteriorate Faster

New DF Fastener

- Clips are Easy to Install
- Quiet Under Load
- $ Extend Life up to 50 years
- Isolate Ground Current

Direct Fixation Fasteners

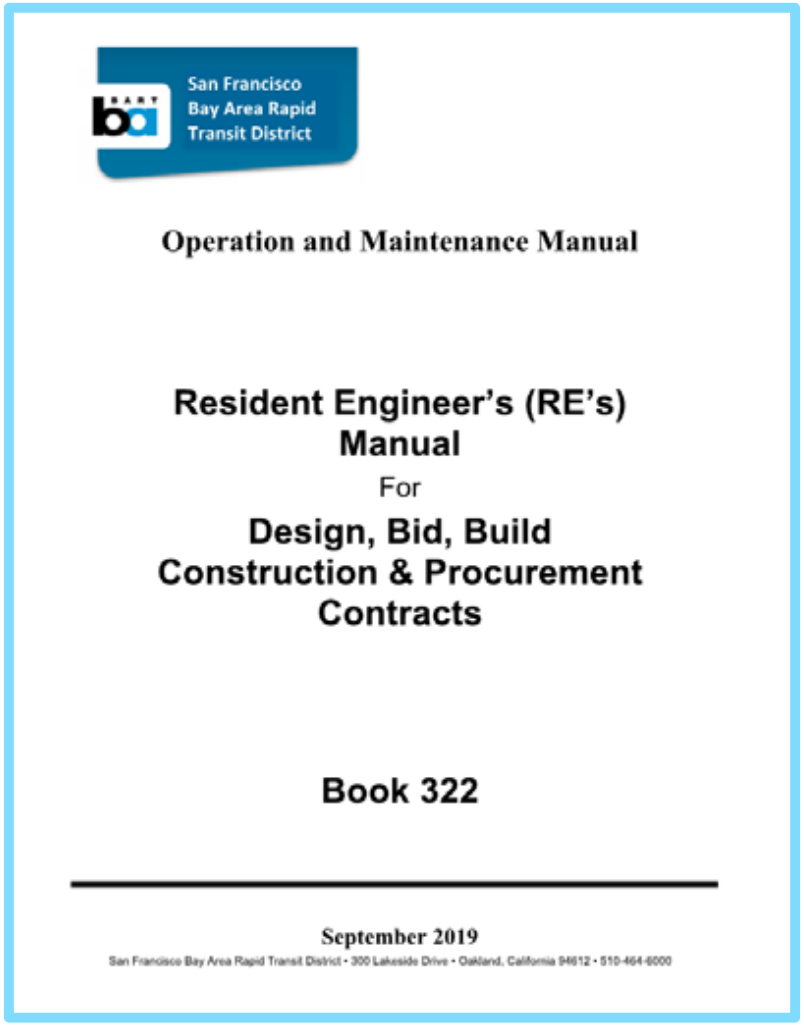
Construction

- ✓ There are 345,000 Fasteners throughout the A,C,M and R lines
- ✓ Funding: 77,000 DF Pads
- ✓ Annual Goal: 10,000 fasteners
- ✓ 50/night with 5-person crew
- ✓ Actually Replaced in 2020: 27,000

Doubled our goal in 2020!

Resident Engineer Manual Update

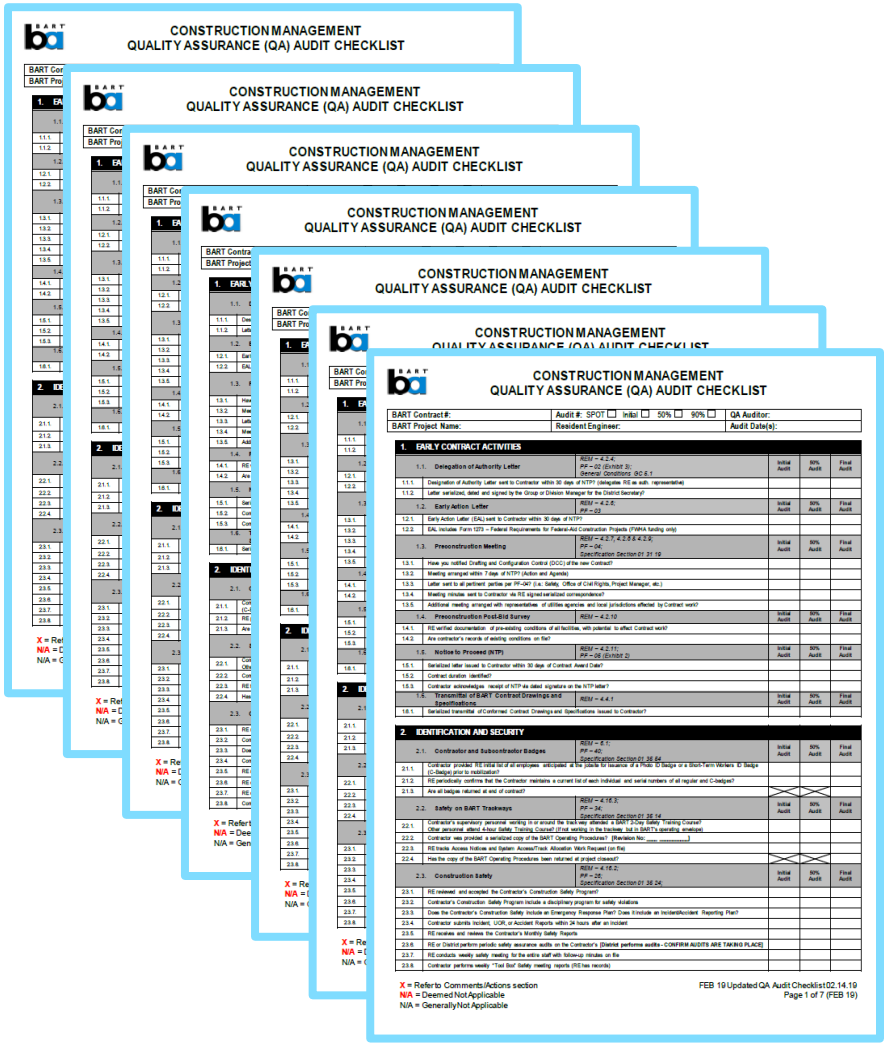
Engineering



- ✓ The RE manual has been completely updated and revised with current policies and procedures. New paragraphs and appendixes have been added to provide more guidance as required.
- ✓ Section 4 was updated to include the most current District procedures in the following (but not limited to):
  - ➢ Preconstruction Preparation
  - ➢ Measurement and Payment
  - ➢ Changes to Contract
  - ➢ Safety Programs
- ✓ Section 7 was created to provide guidance while executing Design-Build (DB) projects.
- ✓ Updated manual provides a comprehensive repository of all commercial construction procedures at BART.

Construction Management QA Audit Checklist

Engineering

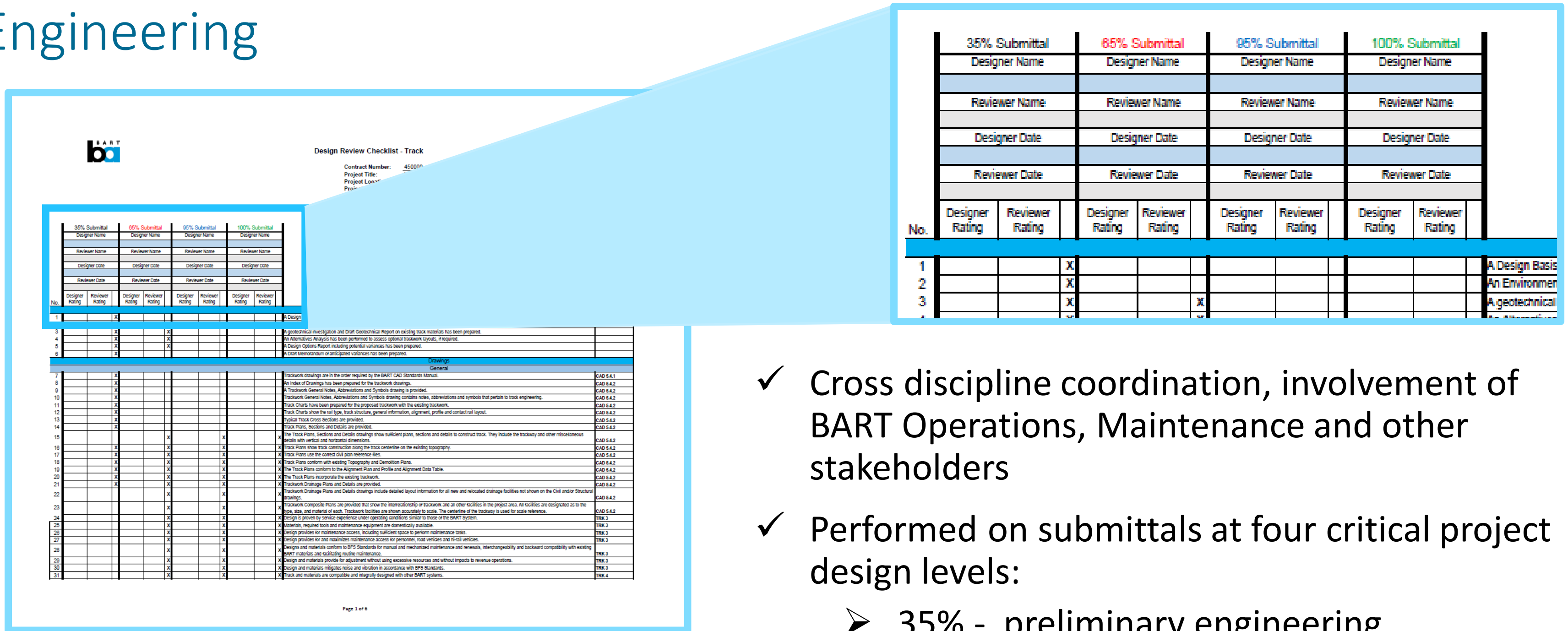


- ✓ Over 200 separate items to be checked during the construction process.
- ✓ The QA Audit Checklist covers:
  - ➢ Early Contract Activities
  - ➢ Identification and Security
  - ➢ Filing System
  - ➢ Contract Drawings Logs, RFI and Submittals
  - ➢ Change Notices and Change Orders
  - ➢ Control of Work
  - ➢ Project Closeout

Cradle-to-grave of all quality check on a BART commercial construction project.

Design Review Checklist

Engineering



- ✓ Cross discipline coordination, involvement of BART Operations, Maintenance and other stakeholders
- ✓ Performed on submittals at four critical project design levels:
  - ➢ 35% - preliminary engineering
  - ➢ 65% - layouts, elevations, profiles, details, references to BART standard drawings, and initial calculations
  - ➢ 95% - construction drawings including details, schedules, and final calculations
  - ➢ 100% - final review and assembly of the construction document

- ➢ *Over 2,000 checklist items*
- ➢ *12 different disciplines*
- ➢ *Reduces future change orders*

Unit Price Bid Sheets

Engineer & Construction

SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT
34.5kV CABLE REPLACEMENT AND FIBER OPTIC CABLE INSTALLATION A-LINE ACO TO AUC
CONTRACT NO. 15EJ-180

ENGINEERS ESTIMATE					
ITEM	UNIT	EST. QTY.	DESCRIPTION	UNIT PRICE	ITEM TOTAL
1.	LS	1	Conduct survey of existing conditions along proposed cable path		
2.	LS	1	Mobilization and Demobilization *		
3.	LS	1	Engineer's Field Office		
4.	Hour	600	Contractor RWP Certification Training		
5.	Hour	10,200	Watchperson		
6.	Hour	48	District Provided Training Other than RWP Certification		
7.	LS	1	Clearing and Grubbing		
8.	EA	5	Remove Trees		
9.	LS	1	Maintenance of Traffic for segment ACO to ASL		
10.	LS	1	Maintenance of Traffic for segment ASL to AWA		
11.	LS	1	Maintenance of Traffic for segment AWA to ABF		
12.	LS	1	Maintenance of Traffic for segment LAA to AHA		
13.	LS	1	Maintenance of Traffic for segment AAY to AUC		
14.	LS	1	Demolish existing AC house and repave site at ASL		
15.	LS	1	Demolish and Salvage Radio Tower Antenna and Control Cabinet at AAY		
16.	LF	15,524	Demolish and dispose of existing left above ground 34.5kV cable system from ACO to ASL		
17.	LF	5,808	Demolish and dispose of existing left above ground 34.5kV cable system from ASL to AWA		
18.	LF	9,028	Demolish and dispose of existing left above ground 34.5kV cable system from AWA to ABF		
19.	LF	21,226	Demolish and dispose of existing above ground 34.5kV cable system from LAA to AHA		
20.	LF	700	Demolish and dispose of existing above ground 34.5kV cable system from ASH TPSS and through the ASH Passenger Station		
21.	LF	7,400	Demolish and dispose of existing above ground 34.5kV cable system from Sta 2003+00 to AUC		
22.	LF	6,907	Furnish Hot Dipped Galvanized HP8 Piles for Soldier Pile Retaining Wall		
23.	EA	727	Install HP8 Piles for Solider Pile Retaining Wall		
24.	EA	5	Install District Furnished 3-Way IDS (ABF-L, AHA-L, AHA-R, ASH-L, ASH-R). Work includes: • Foundations, grounding grids, and fencing • Oil containment and housing for IDSs		
25.	EA	4	Install District Furnished 4-Way IDS (AEY-L, AEY-R, AAY-L, AAY-R). Work includes: • Foundations, grounding grids, pullboxes, and fencing • Oil containment and housing for IDSs		
26.	EA	2	Install District Furnished 5-Way IDS (AUC- L, AUC-R). Work includes: • Foundations, grounding grids, and fencing • Oil containment and housing for IDSs		
27.	LS	1	Testing and place in service segments of 34.5Kv cable between IDSs and or Substations if no IDSs are installed		
28.	LS	1	Testing segments of 288 and 144 strand FO cable between TCRs.		

1 of 5

Thru Addendum 5

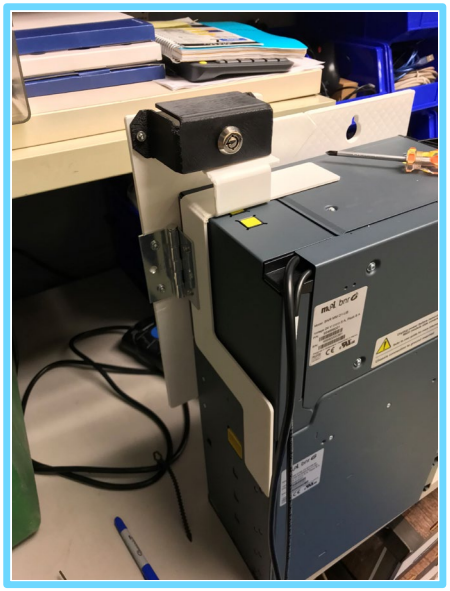
- ✓ Only pay for actual quantities
- ✓ More accurate bids - reduces Contractor's risk
- ✓ Transparency into Contractor cost drivers
- ✓ Difficult to inflate change order cost
- ✓ Engineer's Estimate more closely aligned

A-Line 34.5 kV project
Engineer's Estimate = $111M
Submitted low bid = $107M

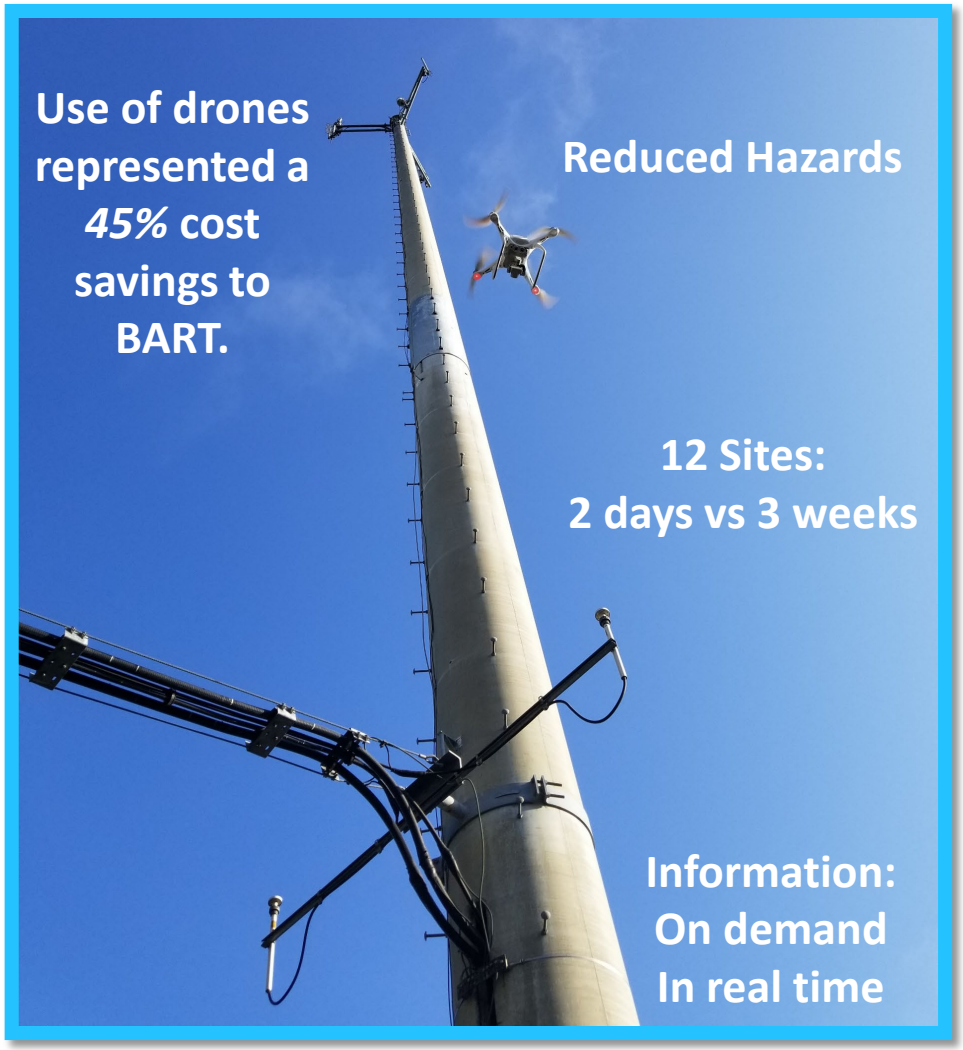
3D Printing
Engineering

- ✓ Saves 1 week per batches of parts
  - ➢ Recent Fare Gate = 70 batches
  - ➢ Do not have to wait for outside vendor

Cost: $5,600
5 mo. Savings: $10,000



Send in the Drones!
Maintenance



Unmanned Aerial Vehicle (UAV)

An UAV is an aircraft piloted remotely using onboard technology to perform inspections. BART used this technology to perform inspections at our 12 Radio Tower sites.

Traditionally tower inspections were performed by personnel called “tower riggers”. These riggers would have to physically climb the towers to visually inspect the towers condition.

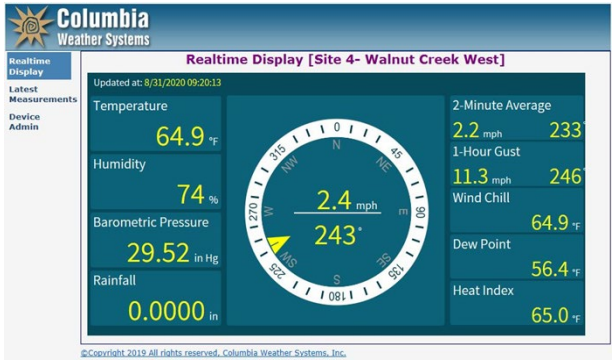
This type of inspection could take a day to accomplish for a tower the height of a cellular tower. With the use of UAVs BART was able to condense the inspection of 12 sites from three weeks to two days!

The cost savings on this was estimated at $3000 per tower site.

Not Just a Weather Station - Environmental Monitoring

Maintenance

- ✓ 4 of 12 Installed in the 5 counties
- ✓ Real time conditions along the right of way
- ✓ Collect atmospheric conditions in real time
- ✓ Facilitates operational decision making
- ✓ Crews dispatched more effectively
- ✓ In the future there will direct interface with the Train Control
- ✓ Rail Kinks and Distressing



Micro Environment Monitoring
Sensing Temperatures in Train Control rooms
Maintenance

Heat issues generally contribute to major delays associated with Train Control as equipment fails during spikes in temperature. Using previous years' data sensors are being installed in the historically worst impacted train control rooms which will allow maintenance to address the problem before it becomes a service problem.

- ✓ BART's 1st Temperature sensors were installed in August
- ✓ Within a few hours, the temperatures within the Train Control Room spiked to 103 ^
- ✓ Maintenance Forces were dispatched
- ✓ Problem resolved before it became a service problem

Next Steps: Wind – the Coverboard's Nemesis

Maintenance

- ✓ Between Sep and June:
  - ➢ 23 incidents of repair needed
  - ➢ > 64 minutes in Delays
- ✓ January and February:
  - ➢ 11 incidents of repair needed
  - ➢ 32 min of delay
- ✓ UC Berkley Students
  - ➢ Developing an algorithm to alert maintenance

Heading off problems before they're a problem for our patrons!

Next Steps: Using Data More and More
Maintenance

- ✓ DC Breakers
  - ➢ Detecting early deterioration
  - ➢ Maintenance actions prior to impacting service
- ✓ Flooding
  - ➢ Sump Pump auto alerts
  - ➢ Yearly problem locations
- ✓ And More …

Heading off problems before they're a problem for our patrons!

If you don’t see it or hear about it, deterioration has been detected early using data which enabled engineering and maintenance action to avoid service disruption!

Questions?