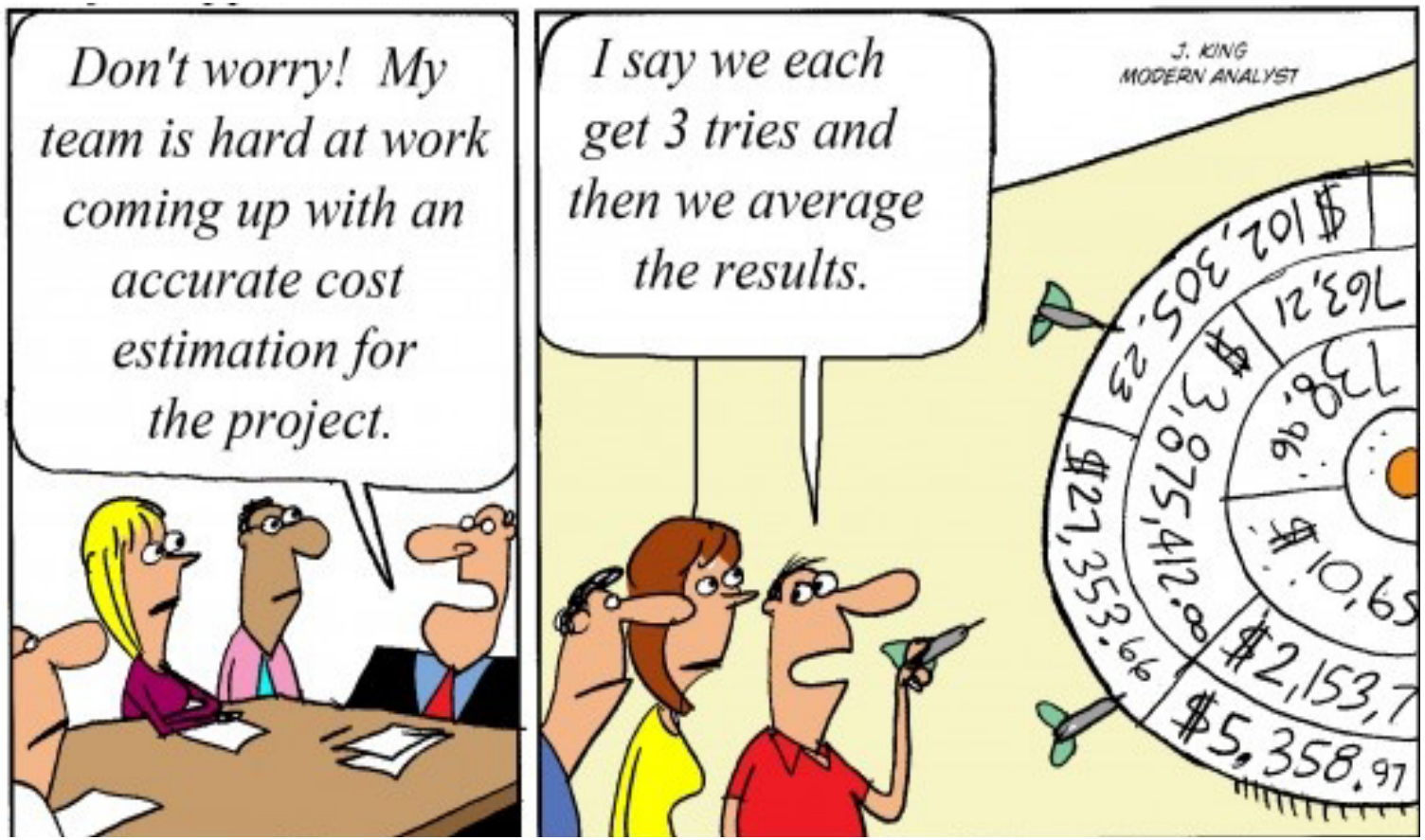
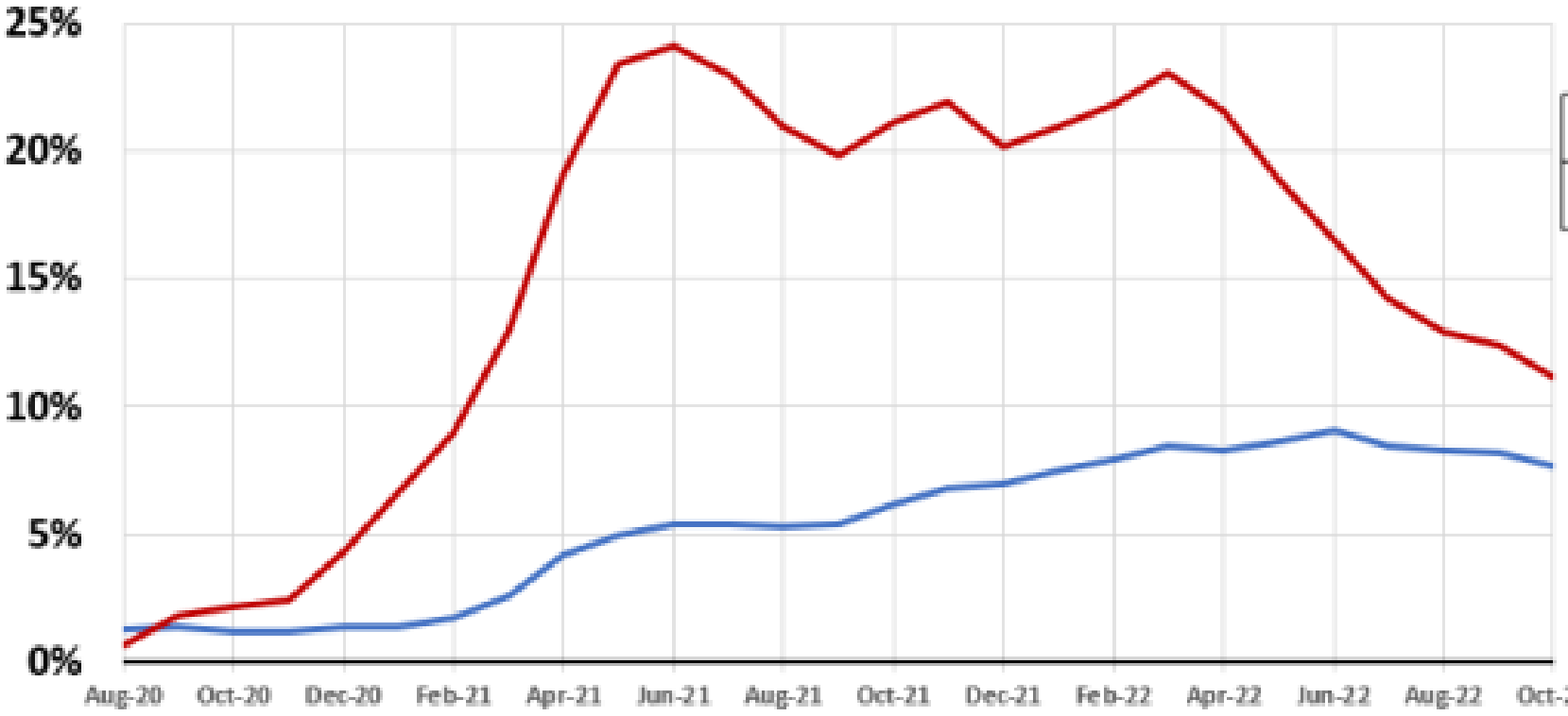


Engineer's Estimate

FEBRUARY 2023

Costs for new nonresidential construction vs. consumer prices

Year-over-year change in PPI for construction inputs and CPI
August 2020 - October 2022, not seasonally adjusted

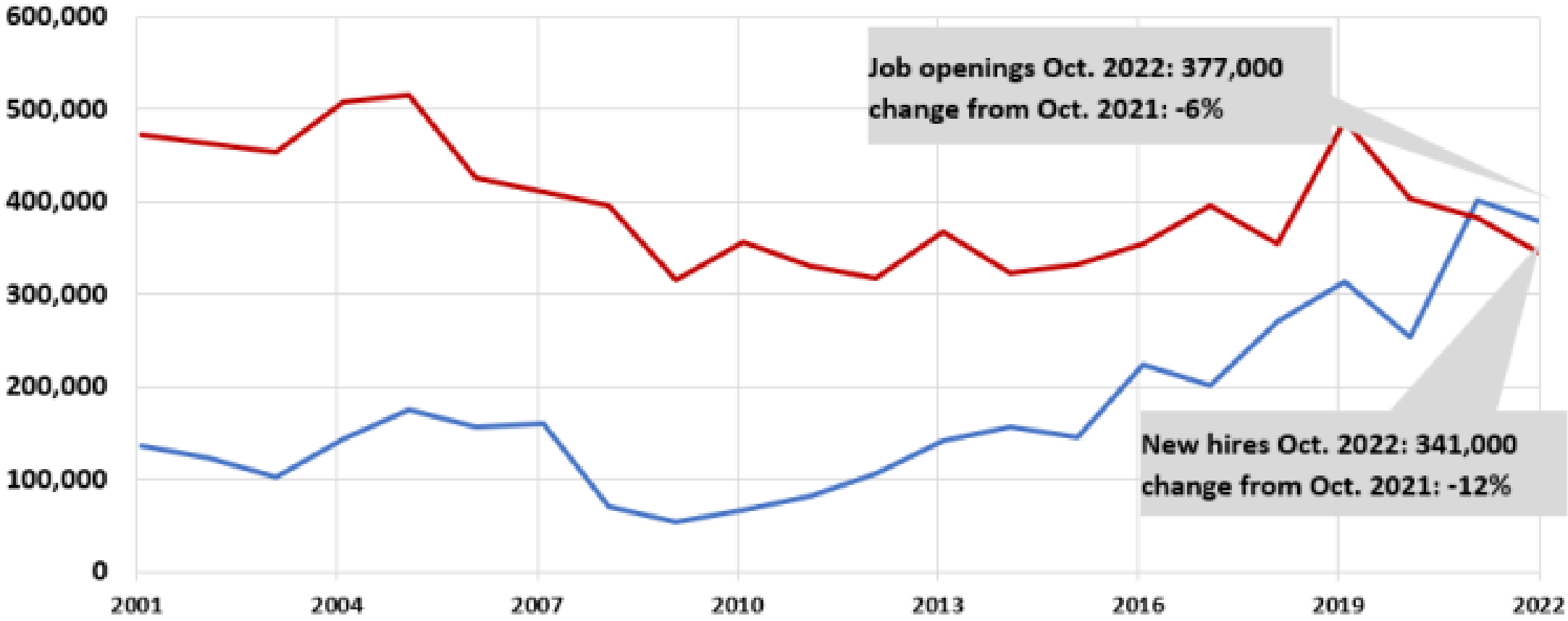


	12 months to:	
	Aug-20	Oct-22
CPI	1.3%	7.7%
Inputs PPI	0.7%	11.2%

Source: Bureau of Labor Statistics, consumer price index, www.bls.gov/cpi; producer price index, www.bls.gov/ppi

Construction job openings & new hires

Job openings and hires, Oct. 2001-Oct. 2022, not seasonally adjusted



Source: Source: Bureau of Labor Statistics, www.bls.gov/jlt, JOLTS

Outcomes

- ✓ Understand our EE corporate goals and overall importance
- ✓ Understand EE development process as outlined in EE Manual
  - ✓ EE Process Requirements
  - ✓ Pay Item Selection
  - ✓ Methods of Estimating
  - ✓ Estimating Considerations
- ✓ Provide eDelivery Update

EE Goals and Importance

- 50% of Projects have an EE within 10% award
- Program Impacts

Central Federal Lands Highway Division

ENGINEER'S ESTIMATE MANUAL

For use with the FP-14

The Requirements

CFLHD STANDARD PRACTICE FOR ENGINEER'S ESTIMATES

Table 1: Cost Estimating Matrix

Project Development Level	Class Description	Purpose of Estimate	Methodology	Approximate Contingency Range *
Project Scoping	Class C	• Set the baseline cost • Verify the Program amount	• Historical-bid based • Cost per mile	25% to 35%
Preliminary Design (15% and 30%)	Class B	• Supports decision-making • Control of project scope and schedule	• Historical-bid based • Cost-based	20% to 30%
Intermediate Design (50%)	Class B	• Supports decision-making • Control of project scope and schedule	• Historical-bid based • Cost-based	10% to 20%
Intermediate Design (70%)	Class A	• Supports decision-making • Control of project scope and schedule	• Historical-bid based • Cost-based	10% to 20%
Final Design (95% and 100%)	Class A	• Obligate construction funds • Evaluate contractor's bids	• Historical-bid based • Cost-based	None

* The contingency is a percentage of the estimated project cost.

Document estimate basis

- Organized and easy to follow
- Communicate

Assumptions

Calculations

Sources of Data

Unknowns

CFL's Project Support Team (PST) Roles and Responsibilities on A/E projects

A/E PROJECT MANAGER

Is responsible for the EE, as the Engineer of Record (AOR)

CFL PROJECT MANAGER

Is responsible for endorsing the estimate developed by A/E.

Reviews the estimate, provides guidance to A/E, verifies against program amount, verifies pay items are appropriate for the project work

Engages the PST on an as-needed basis to assist with estimate review.

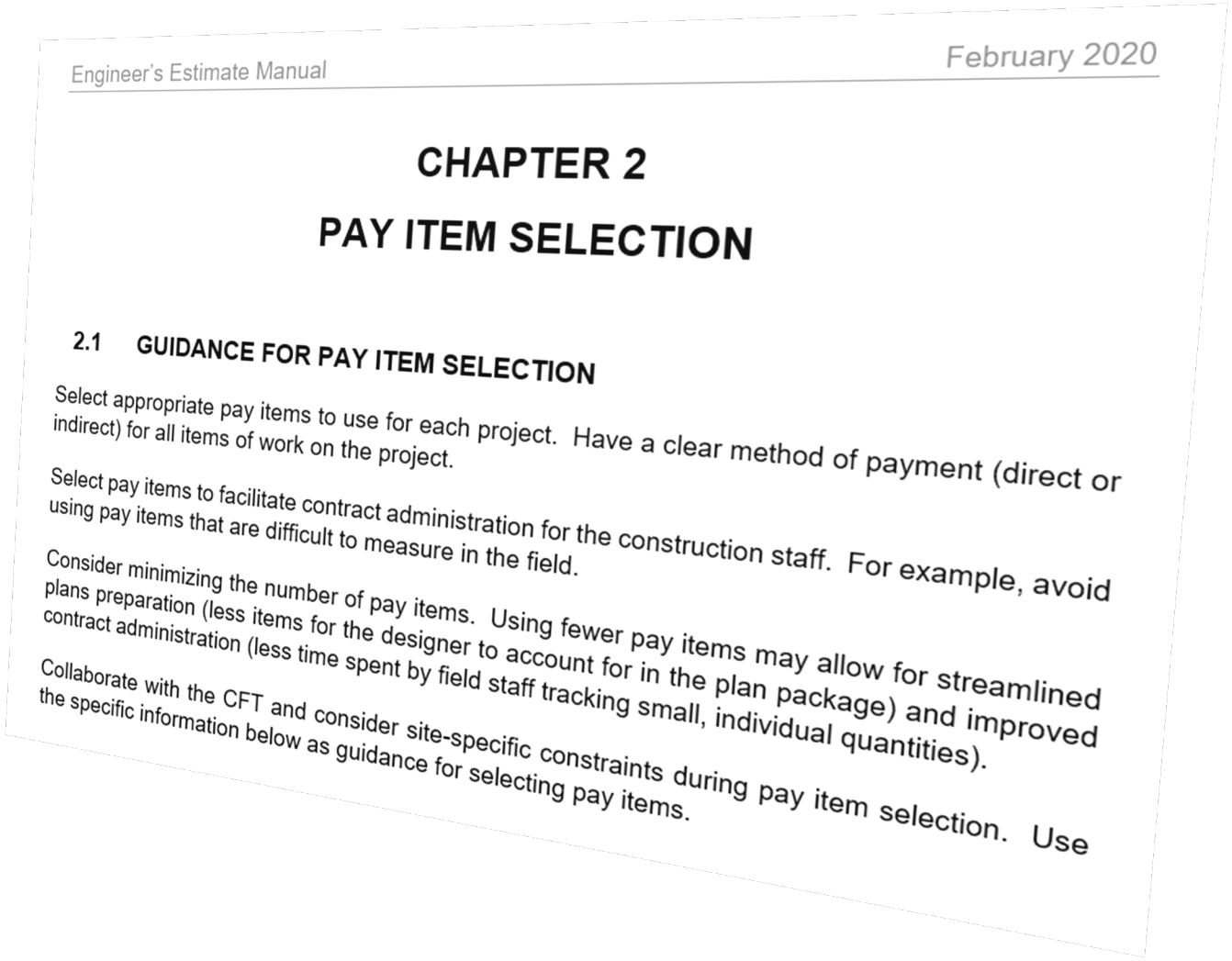
PST

Provide input and recommendations as requested by the Project Manager.

True or False

It has been a year or so, but I remember I put a lot of time into my 70% estimate, coming up with some good unit prices.

For my 95% estimate, all I need to do is update quantities and print it out.



CHAPTER 2

PAY ITEM SELECTION

2.1 GUIDANCE FOR PAY ITEM SELECTION

Select appropriate pay items to use for each project. Have a clear method of payment (direct or indirect) for all items of work on the project.

Select pay items to facilitate contract administration for the construction staff. For example, avoid using pay items that are difficult to measure in the field.

Consider minimizing the number of pay items. Using fewer pay items may allow for streamlined plans preparation (less items for the designer to account for in the plan package) and improved contract administration (less time spent by field staff tracking small, individual quantities).

Collaborate with the CFT and consider site-specific constraints during pay item selection. Use the specific information below as guidance for selecting pay items.

Pay Item Selection

GUIDANCE ON PICKING PAY ITEMS

Mobilization

- Highly variable costs.
- Depends on contractor's business and location.
- May include bonding, special taxes, fees, and permits.
- Unusual submittals
- Should include site specific costs.
- Number of construction seasons.

5.2 SECTION 153 – CONTRACTOR QUALITY CONTROL AND SECTION 154 - CONTRACTOR SAMPLING AND TESTING

Use Table 5 as guidance for estimating contractor quality control and testing

Table 5: Estimating Contractor Quality Control and Contractor Testing

Project Type	Size	Contractor Quality Control Percentage of the Construction Estimate	Contractor Testing Percentage of the Construction Estimate
Projects with limited scope, such as OMAD and pavement preservation projects	All	2%	2%
3R	Smaller (<$5 million)	3.0%	3.0%
3R	Larger (>$5 million)	2.5 - 3.0%	2.5 – 3.0%
4R	Smaller (<$5 million)	3.0 – 3.5%	2.5 – 3.0%
4R	Larger (>$5 million)	3.5 – 4.0%	2.0 – 2.5%

Stringent requirements or unusual structures or materials will add to the typical testing cost. The items that typically add to the testing costs include Section 301, 401, 402, 552, and 551-565 items.

Example Standard Pay Items

SECTION 157 – SOIL EROSION CONTROL

2 methods

15720-0000 Storm Water Pollution Prevention Plan, LPSM and;

ONE of the following:

1) **15701-0000 Soil Erosion Control, LPSM**
2) **Individual pay items** for soil erosion control BMPs (silt fence, fiber roll, stabilized construction entrance, etc.)

Example Standard Pay Items (continued)

SECTION 204 – EXCAVATION AND EMBANKMENT

Projects with waste material:

- **20401-0000 Roadway excavation CUYD**
- *20441-0000 Waste CUYD*

Projects with borrow:

- **20420-0000 Embankment construction CUYD**

Pay for Roadway excavation ***or*** Embankment construction on a project, not both.

Example Standard Pay Items (continued)

SECTION 255 AND SECTION 257

- Section 255: Mechanical Stabilized Earth (MSE) Wall
  - This is for quantities and work
- Section 257: Contractor-Designed Retaining Wall
  - This is for the stamped plans from contractor
- If you have MSE Wall on your projects, there should be pay items for 255 and 257.

Example Standard Pay Items (continued)

SECTION 261 – REINFORCED SOIL SLOPES

- Pay for reinforced soils slopes (RSS) by the CUYD of embankment material **and** the SQYD of geotextile.
  - 20420-0000 Embankment Construction (Reinforced Soil Slope) CUYD
  - 207xx-xxxx SQYD Geotextile
- Coordinate with Geotechnical Engineer to confirm pay items for your specific project.

Example Standard Pay Items (continued)

SECTION 301

UNTREATED AGGREGATE COURSE

- Can be subbase base, base, and surface course aggregate
- Use on Projects with more than 5,000 tons of aggregate base.
- Gradation is statistically accepted. (potential bonus)

SECTION 302

MINOR CRUSHED AGGREGATE

- Can be bedding, backfill, and roadway aggregate
- Use on Projects with less than 5,000 tons of aggregate base
- Gradation is accepted by cert. (contractor can provide local material and no bonus)

Example Standard Pay Items (continued)

SECTION 401 ASPHALT CONCRETE PAVEMENT BY GYRATORY MIX DESIGN METHOD

- Use on Projects with more than 7,000 tons of asphalt.
- Gradation is statistically accepted. (potential bonus)
- Includes warm mix and safety edge.
- Add antistrip pay item.

SECTION 403 ASPHALT CONCRETE

- Use on Projects with less than 7,000 tons of asphalt. Type depends on tonnage.
- Gradation is accepted by cert. (contractor can provide local material and no bonus)
- Uses local mix (i.e. state DOT).

Example Standard Pay Items (continued)

SECTION 622 – RENTAL EQUIPMENT

SECTION 623 – GENERAL AND SPECIAL LABOR

Include equipment hours and labor in the contract to facilitate contract administration for the Project Engineer.

Also consider environmental surveys or monitoring that we're paying for here (Special Labor).

Example Standard Pay Items (continued)

SECTION 635 – TEMPORARY TRAFFIC CONTROL

Lump Sum 

Individual Items

- Work with PM and COE
- Communicate and Document

Methods of Estimating

BID HISTORY AND COST BASED UNIT PRICE

Bid history vs. cost-based

HISTORICAL BID BASED

Most common method

Minor cost items (80%)

Pro: Straightforward

Con: Lack of data or knowledge of projects being used for UPA

COST BASED

Less common method

Major cost items (20%)

Pro: Project-specific

Con: Takes more time, effort, skill

Historical Bid Considerations

- Identical or similar items
- Recent projects
- Projects near the same geographic region or have similar topography and density
- Consider if inflation is needed

Bid History Sources of Data

- CFL / EFL / WFL bid history
- State DOT
- Partner agency data

Historical Bid Cautions

LUMP SUM ITEMS

UNIQUE ITEMS

Cost Based

- Direct (Materials, Equipment and Labor) and Indirect Costs (OH, Profit, etc.)
- Major items of work
  - Earthwork
  - Aggregate base
  - Asphalt pavement
  - Major structures
- Other Items with insufficient bid history data or unique items

Cost Based Unit Price Spreadsheet

Available on website:

https://flh.fhwa.dot.gov/resources/design/tools/cfl/documents/eebacs/Cost_Base_Unit_Price.xlsx

Cost-Based Unit Price

Project Name and #:	**AZ PFH 123-1(1) Example Road**
Pay Item Number:	**25205-1000**
Description:	**ROCK BUTTRESS, MECHANICALLY-PLACED**
Quantity:	**1,500**
Unit:	**CUYD**

ASSUMPTIONS

Description	Assumed Value	Remarks
Production rate	750 CY/day	Remote location. Steep, inaccessible slopes.

EQUIPMENT

	Description (1)	Quantity (2)	Unit	Cost / Unit (includes OH&P) (3)	Total Cost / Hour	Remarks (4)
Equipment 1	Cat 330 Excavator	20	hour	$ 106.15	$ 2,123.00	From RS Means
Equipment 2	End dump; 10 CY	12	hour	$ 33.50	$ 402.00	From RS Means
				TOTAL	**$ 3,317**	

(1) Show the type of equipment selected, including the size of the equipment.
(2) Make sure the quantities are appropriate for the production rate selected. (e.g. if you think the work will take 2 days, make s
production rate is appropriate for the type and size of equipment (see RS Means or Cat website for equipment production rates)
(3) These costs/unit can be obtained from historical bid prices or from RS Means.
(4) Note where the information was obtained.

LABOR

	Description (1)	Quantity	Unit	Cost / Unit (2)	Subtotal	Payroll Burden (3)	Subtotal
Labor 1	Power equipment operator	40	hour	$ 31.52	$ 1,260.80	35%	$ 1,702.08
Labor 2	Laborers	30	hour	$ 19.29	$ 578.70	35%	$ 781.25
Labor 3	Truck driver	12	hour	$ 24.25	$ 291.00	35%	$ 392.85

(1) See RS Means for suggested typical crews for various operations.
(2) Use Davis-Bacon labor rates (https://beta.sam.gov/search?index=wd&date_filter_index=0&date_rad_selection=date&wdType
Bacon, use judgment where rates aren't available.

Independent Government Estimate- Cost Based

Project:	**CA FTNP YOSE 15(2)**				
Description:	**401- Asphalt Gyratory**				
By:	N. Allen				
Date:	9/9/2020				
			Total Cost:	**$5,634,562.55**	
Quantity:	**26,400**	**TON**	**Unit Cost:**	**$213.43**	
Production Rate/Day:	800	Material/Haul Unit Cost:		$157.33	
Total Days:	**33**	Haul Hours/Load (HPL):		**7.0**	See haul worksheet
Hours per Day:	8				
Total Crew Hours:	**264**				

Materials	Unit	Quantity	Unit Cost	Total Cost	Remarks
HACP	TONS	26,400	$97.43	$2,572,152.00	Quote from Vulcan mat
Haul	HOUR	10,269	$154.00	$1,581,426.00	8/20 trucking quote of $
			Materials Total	**$4,153,578.00**	

Labor	#	Total Hrs	Unit Cost	Total Cost	Remarks
Foreman -multi equipment	1	264	$87.85	$23,192.40	Power Equipment Ope
Laborer- AC Raker	2	528	$60.24	$31,806.72	Laborer (Construction $
Laborer- AC Shoveler	2	528	$59.39	$31,357.92	Laborer (Group 2)
MTV operator	1	264	$82.19	$21,698.16	Power Equipment Ope
Paving machine operator	1	264	$83.46	$22,033.44	Power Equipment Ope
Asphalt Roller operator	3	792	$83.46	$66,100.32	Power Equipment Ope
Screedman	2	528	$82.19	$43,396.32	Power Equipment Ope
			Subtotal	$239,585.28	
		30.0%	Labor Burden	$71,875.58	
			Labor Total	**$311,460.86**	

Equipment	#	Total Hrs	Unit Cost	Total Cost	Remarks
Pickup- F250	4	1056	$27.42	$28,955.52	Caltrans 2020 Equip.
Cat AP-1000 Paver	1	264	$183.25	$48,378.00	Caltrans 2020 Rates
Cat CB 634 Vibratory Roller	1	264	$101.27	$26,735.28	Caltrans 2020 Rates
Dynapac CP2100 rubber tire	1	264	$49.97	$13,192.08	Caltrans 2020 Rates
Bomag BW 151AD Finish Roller	1	264	$57.46	$15,169.44	Caltrans 2020 Rates
Roadtec SB2500B- MTV	1	264	$224.22	$59,194.08	Caltrans 2020 Rates
			Equipment Total:	**$191,624.40**	
			Overall Subtotal:	**$4,656,663.26**	**Field Cost**
		10.0%	OH:	$465,666.33	
		10.0%	Profit:	$512,232.96	
			TOTAL:	**$5,634,562.55**	

Sources of Data

CFL

- Production Rate Spreadsheet on FLH website
- Historical bid prices (equipment/labor)
- PST

RS Means

- Crews and Production Rates

https://beta.sam.gov/

- Davis-Bacon Wages
  - *Inflate older surveyed wages*
- EIA.gov
  - Fuel & Energy Costs

Partners

Vendors/Suppliers

- Material quotes
- Crews and Production Rates
- Haul cost

Equipment

- USACE Equipment book
- CALTRANS Equipment

Per Diem

- https://www.gsa.gov/travel/plan-book/per-diem-rates

Estimating Considerations

GUIDANCE AND ‘RULES OF THUMB’

Estimating Lump Sum Items

Quantify the work included in the item

Use historical or cost based data to establish unit prices for each item of work

Make project specific adjustments if required

Tabulate to establish the Lump Sum estimated cost

20304-1000 REMOVAL OF STRUCTURES AND OBSTRUCTIONS								
Line A0180	ALL	LPSM	$	15,000.00	$	15,000.00	$	5,000.00	$	5,000.00	$	45,000.00	$	45,000.00

63501-0000 TEMPORARY TRAFFIC CONTROL								
Line A0540	ALL	LPSM	$	25,000.00	$	25,000.00	$	40,000.00	$	40,000.00

Subsidiary Items

Include the costs of subsidiary items in the estimated cost of the related item

Don’t assume that because items are included that they are free!

- Subsidiary items can increase the cost similar to lump sum items
- Add unknowns to contracts

Verify it’s clear in the SCRs how items are paid for.

Project Conditions

SIZE

- Unit prices for larger quantities are generally less expensive than smaller quantities

GEOGRAPHIC LOCATION

- Distance from Materials sources (Longer Haul = Higher Unit Prices)
- Availability of local employees

TRAFFIC CONDITIONS

- Traffic volume
- Delays and closure

ACCESSIBILITY

- Terrain

Restrictive Conditions

Night Work and Short Shifts

Environmental Commitments

Handwork vs. Heavy Equipment

Other Estimating Considerations

TIMING OF ADVERTISEMENT

CONSTRUCTION SEASON

- Winter shutdown?
- Accelerated schedule?
- Consider escalation clauses if schedule is long (year or longer). SCR Section 109.

AVAILABILITY OF MATERIALS

- Commonly used materials generally cost less.
- Special material requirements or special gradations can cost more.
- Material shortages can also increase costs (and time).

Other Estimating Considerations

INFLATION

- Cost Inflation Indices spreadsheet
- EEBACS includes inflation indices and has the ability to inflate individual unit prices

ESCALATION

- Estimate to current year cost
- Escalate the estimate to Program Year at each milestone

RISK

- Projects and pay items that transfer more risk to the contractor can lead to higher bid prices.

eDelivery Update

FHWA is replacing the existing roadway cost estimating, acquisitions, and construction managements system (EEBACS and OneNote) and add additional capabilities, with a single comprehensive web-based and mobile eDelivery system.

- FLH's objectives for this project include:
  - Improve the capability and efficiency for FLH staff to capture project documentation in the design, procurement and management phases of construction projects;
  - Replace the existing roadway cost estimating system;
  - Add eBidding capabilities; and
  - Add construction document management
- Currently Testing/Configuring
- Expected to go live Fall 2023, with training prior

Questions?