



## Engineer's Estimate February 2021

## EE Goals and Importance



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

## CFL's EE Team

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- EE Team formed in the summer of 2019
- EE Team updated processes and the EE Manual and provided training opportunities

Central Federal Lands Highway Division

# ENGINEER'S ESTIMATE MANUAL

For use with the FP-14  
January 2021

# The Requirements

CFLHD STANDARD PRACTICE FOR ENGINEER'S ESTIMATES



Engineer's Estimate at every project milestone  
From Scoping through Final Design, always consider cost

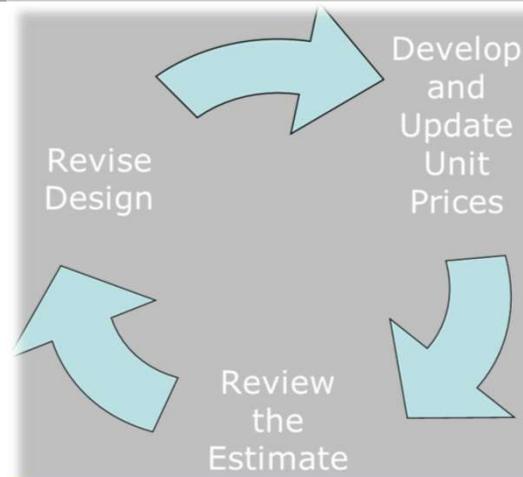
Table 1: Cost Estimating Matrix

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

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

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## Use consistent, comprehensive method



## Document estimate basis

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- Organized and easy to follow
- Communicate

**Assumptions**

**Calculations**

**Sources of Data**

**Unknowns**



### Collaborate with the Project Team

Developing the Engineer's Estimate is collaborative effort performed by the Cross Functional Team (CFT).

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

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### **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.

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### **PST**

Provide input and recommendations as requested by the Project Manager.



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Retain confidentiality

Maintain integrity of the bidding and procurement process

## 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.



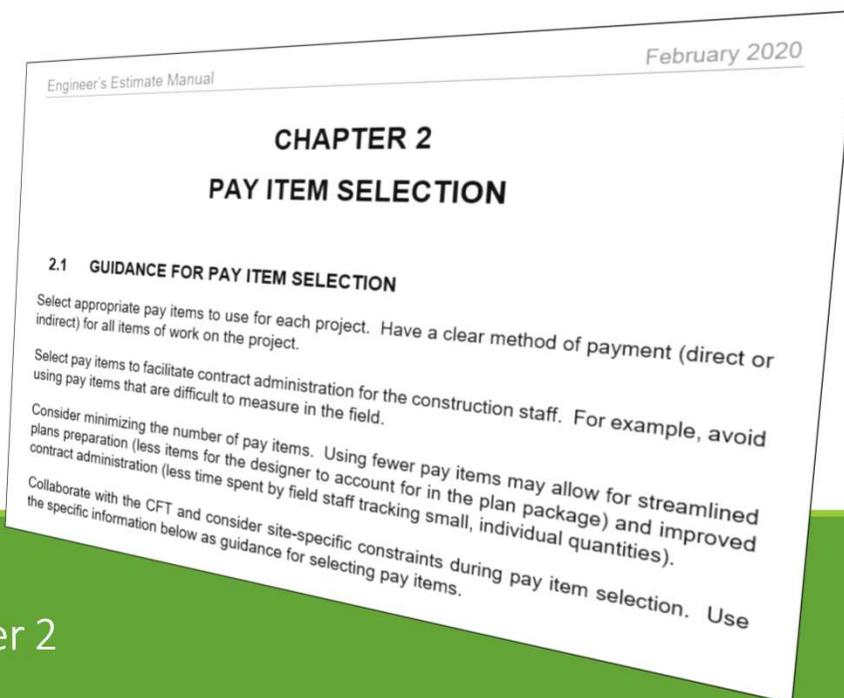
## True or False

No one from CFL ever looks at my unit price analysis, so I don't really need to write anything down.



# Pay Item Selection

GUIDANCE ON PICKING PAY ITEMS



Chapter 2

## Example Standard Pay Items

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### SECTION 203 – REMOVAL OF STRUCTURES AND OBSTRUCTIONS

20304-1000 Removal of Structures and Obstructions LPSM pay item:

For removal of various structures and obstructions that are easily identified in the field

Broken out into various pay items:

For removal items that are underground or are anticipated to be high-cost or high risk items.

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## Example Standard Pay Items (continued)

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### 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.

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## Example Standard Pay Items (continued)

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### 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.

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## Example Standard Pay Items (continued)

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### 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.

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## 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)

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## 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).

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## Example Standard Pay Items (continued)

### SECTION 622 – RENTAL EQUIPMENT

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).*



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## Methods of Estimating

BID HISTORY AND COST BASED UNIT PRICE

## Bid history vs. cost-based

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### **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 Based

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### Minor items of work

- Erosion control
- Guardrail
- Landscaping
- Minor hydraulic items (culverts, etc)
- Curb and gutter
- Sidewalk
- Riprap
- Fencing and cattleguards
- Temporary traffic control
- Signing and striping

## Historical Bid Considerations

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- 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

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

## Historical Bid Cautions



LUMP SUM ITEMS



UNIQUE ITEMS

## Cost Based

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### Major items of work

- Earthwork
- Aggregate base
- Asphalt pavement
- Major structures

Other Items with insufficient bid history data or unique items

# Cost Based

Price = Direct Costs + Indirect Cost

**Direct Costs:**

- Labor
- Equipment
- Material

**Indirect Costs:**

- Overhead – 10% average
- Subcontractor Markup – additional 10% if applicable
- Profit – 10%

Typical OH&P Factor Range = 1.15 to 1.35

# Cost Based Unit Price Spreadsheet

Available on website:

[https://flh.fhwa.dot.gov/resources/design/tools/cfl/documents/eebacs/Cost\\_Base\\_Unit\\_Price.xlsx](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: CUVD						
ASSUMPTIONS						
Description	Assumed Value	Remarks				
Production rate	750 CY/day	Remote location. Steep, inaccessible slopes.				
EQUIPMENT						
Description <sup>(1)</sup>	Quantity <sup>(2)</sup>	Unit	Cost / Unit (Includes OH&P) <sup>(3)</sup>	Total Cost / Hour	Remarks <sup>(4)</sup>	
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	
<b>TOTAL</b>			<b>\$ 3,317</b>			
(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 a 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 <sup>(1)</sup>	Quantity	Unit	Cost / Unit <sup>(2)</sup>	Subtotal	Payroll Burden <sup>(3)</sup>	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 ( <a href="https://beta.sam.gov/search?index=wx&amp;date_filter_index=0&amp;date_rad_selection=date&amp;wdType=Bacon_use_judgment_where_rates_arent_available">https://beta.sam.gov/search?index=wx&amp;date_filter_index=0&amp;date_rad_selection=date&amp;wdType=Bacon_use_judgment_where_rates_arent_available</a> ) (3) Bacon use judgment where rates aren't available.						

Independent Government Estimate - Cost Based						
Project: CA FTNP YOSE 19(2)						
Description: 401- Asphalt Gyrotray						
By: N. Allen						
Date: 9/9/2020						
Quantity: 26,400 TON			Total Cost:	\$5,634,562.55		
Production Rate/Day: 800			Material/Haul Unit Cost:	\$213.43		
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	
H&P	TONS	26,400	\$97.43	\$2,572,152.00	Quote from Vulcan mat	
Haul	HOUR	10,269	\$154.00	\$1,581,426.00	@20 trucking quote of	
<b>Materials Total</b>				<b>\$4,153,578.00</b>		
Labor	#	Total Hrs	Unit Cost	Total Cost	Remarks	
Foreman (multi equipment)	1	264	\$57.85	\$15,292.40	Power Equipment Ops	
Laborer- AC Roller	2	528	\$50.24	\$26,526.72	Laborer (Construction)	
Laborer- AC Spreader	2	528	\$59.39	\$31,357.92	Laborer (Group 2)	
MTV operator	1	264	\$82.19	\$21,698.16	Power Equipment Ops	
Paving machine operator	1	264	\$83.46	\$22,033.44	Power Equipment Ops	
Asphalt Roller operator	3	792	\$83.46	\$66,100.32	Power Equipment Ops	
Screedman	2	528	\$82.19	\$43,396.32	Power Equipment Ops	
			Subtotal	\$239,585.28		
			30.0% Labor Burden	\$71,875.58		
			<b>Labor Total</b>	<b>\$311,460.86</b>		
Equipment	#	Total Hrs	Unit Cost	Total Cost	Remarks	
P-13hp-250	4	1056	\$27.42	\$28,855.32	Caltrens 2020 Equip	
Cat AP-1000 Paver	1	264	\$183.25	\$48,378.00	Caltrens 2020 Rates	
Cat CB 634 Vibratory Roller	1	264	\$191.27	\$50,735.28	Caltrens 2020 Rates	
Dynapac CP-100 rubber tire	1	264	\$49.97	\$13,192.08	Caltrens 2020 Rates	
Bomag BW 151AD Finish Roller	1	264	\$57.46	\$15,169.44	Caltrens 2020 Rates	
Roadtec SB2500B-MTV	1	264	\$224.22	\$59,194.08	Caltrens 2020 Rates	
<b>Equipment Total:</b>				<b>\$191,624.40</b>		
<b>Overall Subtotal:</b>				<b>\$4,656,663.26</b>	<b>Field Cost</b>	
				10.0% OH:	\$465,666.33	
				10.0% Profit:	\$512,232.96	
				<b>TOTAL:</b>	<b>\$5,634,562.55</b>	



# 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



## Project Conditions (continued)

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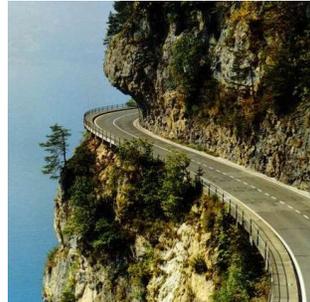
### TRAFFIC CONDITIONS

- Traffic volume
- Delays and closure



### ACCESSIBILITY

- Terrain



## Restrictive Conditions

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Night Work and Short Shifts  
Environmental Commitments  
Handwork vs. Heavy Equipment



## Other Estimating Considerations

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### TIMING OF ADVERTISEMENT

#### CONSTRUCTION SEASON

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

### AVAILABILITY OF MATERIALS

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

## Other Estimating Considerations

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### 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.

## Rounding

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**Note: Estimates are approximations**

(See Table 2 for guidance on rounding bid prices.)

Round the estimate to the nearest appropriate significant digit.  
Adjust the mobilization to show a rounded total estimated cost.

Example:     \$1,348,127.58 rounded to \$1,350,000  
               \$12,479,697.35 rounded to \$12,480,000

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## Specific Pay Items

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ESTIMATING COMMON LPSM 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.

### 5.3 SECTION 155 – SCHEDULES FOR CONSTRUCTION CONTRACTS

For projects less than \$2 million use a minimum of \$10,000 for the construction schedule cost.

For all other projects, estimate construction schedules as 0.5% of the construction estimate.

Projects involving more complex temporary traffic control plans or multiple construction seasons may require additional time and resources for developing the construction schedule. For these projects estimate construction schedules as 1.0% of the construction estimate.

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## Questions?

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