

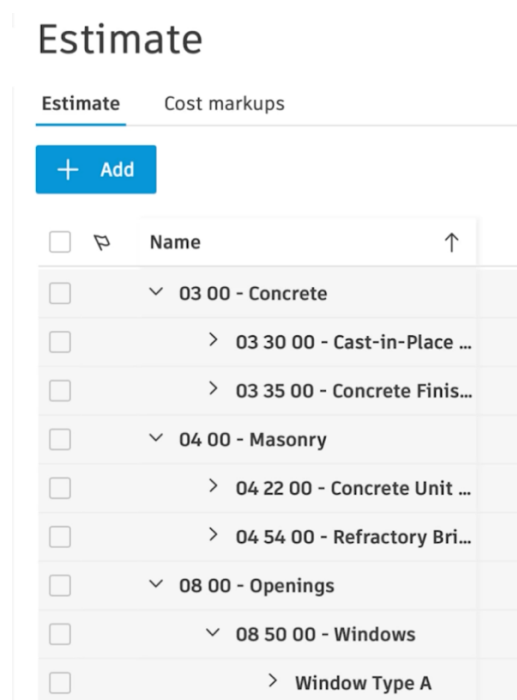
Project challenge – Grading rubric

Estimate costs of systems components in Forma Preconstruction

Using Forma Preconstruction, perform quantity takeoff and cost estimating for the project's mechanical and plumbing systems in the provided model **Systems model.rvt**.

Scenario:

As construction estimator, your goal is to quantify ductwork, piping, HVAC equipment, and plumbing fixtures, then develop a complete estimate that includes direct and indirect costs.



Estimate		Cost markups
+ Add		
☐	Name	↑
☐	03 00 - Concrete	
☐	> 03 30 00 - Cast-in-Place ...	
☐	> 03 35 00 - Concrete Finis...	
☐	04 00 - Masonry	
☐	> 04 22 00 - Concrete Unit ...	
☐	> 04 54 00 - Refractory Bri...	
☐	08 00 - Openings	
☐	> 08 50 00 - Windows	
☐	> Window Type A	

Complete the required activities

- Using the included model, **Systems model.rvt**, identify all mechanical system components in the project, including ductwork, air terminals, VAV boxes, air handling units (AHUs), and centrifugal fans. Verify that each component is correctly classified and can be isolated in Takeoff or the model viewer for quantity extraction.

- Create and use appropriate takeoff types to measure ductwork by size and length. Group duct quantities according to their dimensions and prepare outputs that can be transferred into the estimate.
- Identify all plumbing system components, including piping, water closets, urinals, lavatories, water heaters, and centrifugal pumps. Separate piping by diameter and measure the total length for each pipe size.
- Transfer all quantities into Estimate and apply the appropriate unit costs to each system component. Confirm that quantities are mapped correctly to estimate items before calculating costs.
- Calculate the total direct cost of the project by combining the costs for mechanical equipment, plumbing fixtures, ductwork, and piping. Summarize direct costs by major system to verify that all project scope has been captured.
- Calculate the total indirect costs of the project by applying 5% overhead and 3% contingency to the total direct cost. Document how these percentages are applied so the calculations can be reviewed and repeated.
- Calculate the total project cost by combining direct and indirect costs into a final project estimate. Review the estimate to verify that all mechanical and plumbing work included in the model has been captured.

Success criteria

- **Accurate quantities:** Mechanical and plumbing quantities are measured accurately, with ductwork, piping, equipment, and fixtures correctly identified and quantified.
- **Accurate mapping:** All quantities are correctly transferred to Estimate and mapped to the appropriate cost items.
- **Accurate costs:** Direct costs, overhead, contingency, and the final project cost are calculated correctly and summarized by system.

What to submit

- **Forma Preconstruction:** Your instructor has access to your work on Autodesk Forma for Construction so there is no need to submit anything beyond the required activities above.
- **Estimate report:** Submit an Estimate report showing all quantities, unit costs, direct costs, indirect costs, and the final project cost.

Suggested unit costs

For these exercise, these are sample values that include material, labor, equipment, and typical contractor productivity, and represent the cost of purchasing and installing the component.

Component	Unit	Suggested cost
Rectangular duct (all sizes)	LF	\$42 / LF
Round duct (all sizes)	LF	\$36 / LF
Pipe (1–2")	LF	\$24 / LF
Pipe (2½–4")	LF	\$38 / LF
Pipe (6"+)	LF	\$72 / LF
Air terminal (diffuser/grille)	EA	\$425
VAV box	EA	\$3,200
Air handling unit	EA	\$58,000
Centrifugal fan	EA	\$12,500
Water closet	EA	\$2,350
Urinal	EA	\$1,850
Lavatory	EA	\$1,250
Water heater	EA	\$8,900
Centrifugal pump	EA	\$9,800

Grading rubric

	Advanced	Proficient	Basic	Emerging
Quantity accuracy	All mechanical and plumbing quantities are calculated correctly, including ductwork, piping, equipment, and fixtures, with accurate classifications and takeoff outputs.	Most quantities are accurate with only minor inconsistencies.	Several quantity errors or missing components are present.	Major errors or incomplete quantity takeoff.

Cost mapping	All quantities are correctly mapped to estimate items, and direct, overhead, and contingency costs are applied accurately using the specified unit rates.	Most quantities are mapped correctly with only minor calculation or mapping errors.	Some quantities are incorrectly mapped or cost calculations contain noticeable errors.	Little to no correct cost mapping or cost calculations are completed.
Final cost summary	Final project cost is complete, well organized, and accurately combines all direct and indirect costs for the mechanical and plumbing systems.	Final project cost is mostly accurate with only minor discrepancies.	Final project cost contains errors or is missing some system costs.	Final project cost is incomplete, unclear, or unsupported by the estimate.