"COST EFFECTIVE ALTERNATIVE METHODS FOR STEEL BRIDGE PAINT SYSTEM MAINTENANCE"

CONTRACT NO. DTFH61-97-C-00026

COST MODEL EXAMPLES

WRITTEN FOR THE FEDERAL HIGHWAY ADMINISTRATION
BY: CORRPRO COMPANIES INC.
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INTRODUCTION

This document provides example analyses using a cost model for bridge painting maintenance. The model was developed to aid specifiers in evaluating the costs associated with currently available painting technologies and allows comparisons between many of the current painting options for steel bridges. The "Cost Model User's Guide" was also developed under this project and describes the model's primary components, features, and basic operation.

We will describe the steps involved with setting up the first example, then advance to describe the additional capabilities of the cost model through further examples. Before the examples are described, it is important to note the following:

- These types of analysis will be highly influenced by particulars of each job. Because of this variability, the usefulness of this model is to define the relative sensitivity of each scenario to each variable.
- This model will provide estimated cost output detailed to the level of the penny. However, the actual cost of a job will be influenced by variables impossible to capture in this model.
- Users are cautioned not to use this model to determine the absolute value of any one project, but to use the model as a gauge for the difference between available painting options for a single project.

EXAMPLE 1 – FULL COATING REMOVAL COMPARED TO OVERCOATING

Our first scenario is a situation where the overall painting scope of work is based on a combination of the initial condition of the structure and the cost of the project. This analysis will place perspective on the cost aspects of the decision. We will compare a full coating replacement painting option with a spot preparation and overcoating painting option. The analysis will be based on varying the percent deterioration of the existing coatings on the bridge.

1. Use the Input spreadsheet to set up the project constraints (initial conditions) for this scenario. We have selected the example data shown at the right.

Item	Input
Bridge Square Footage	25,000
percent deteriorated	20.0%
Forman	1
Blaster/Painter	4
Helper	2
Average Labor Rate	$ 26.00
Hours/Day	8.0
Lead in coating	Yes
Washing	Yes
Dehumidification	No
Pretox	No
Blastox	No
Rapid Deployment	No
Stripe Coat	Yes

2. Further down the Input spreadsheet, select the operating parameters (the painting options) for the spot preparation and overcoating option. We have chosen the following:

Category / Selection Area	Select this
Full Removal Surface Preparation	*0. Spot-Sweep Preparation*
Spot-Sweep Surface Preparation	*1. Hand Tool Cleaning*
Staging/Containment Options	*1. Lift Trucks*
Coating System Options	*1. Three Coat System*
Coating Application Options	*4. Airless Spray*

3. View the cost model output on the Output spreadsheet. The result is an overall cost/ft^2 of $6.87. Note that this cost will change depending upon the production factors selected (colored cells of the Input Spreadsheet) and the Cost Variables (colored cells of the Cost Variables spreadsheet). Your output should look like the following:

Cost Effective Alternate Methods for Steel Bridge Paint System Maintenance

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Cost Model Spreadsheet - Results Page

For a Bridge Project with:

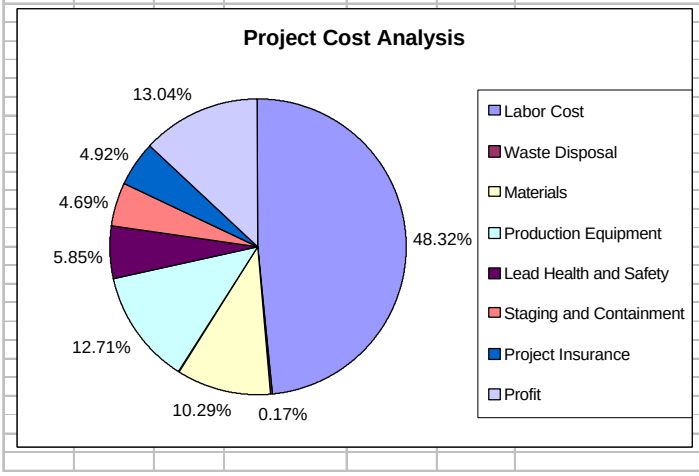
25,000	Paintable Square Feet
20.0%	Percent Area Deteriorated
7	Persons in the Work Crew

The Costs to:

- Contain the bridge using Lift Trucks
- Perform spot cleaning with hand tools
- Airless spray apply a three coat system

are given below.

	Item Cost	Item Percentage	Cost / SF	Select below to send results to the "Comparison Page"
Labor Cost	$ 82,992.00	48.32%	$ 3.32	Copy as "Option 1"
Waste Disposal	$ 297.38	0.17%	$ 0.01	
Materials	$ 17,673.25	10.29%	$ 0.71	
Production Equipment	$ 21,829.00	12.71%	$ 0.87	Copy as "Option 2"
Lead Health and Safety	$ 10,050.00	5.85%	$ 0.40	
Staging and Containment	$ 8,052.74	4.69%	$ 0.32	
Project Insurance	$ 8,453.66	4.92%	$ 0.34	Copy as "Option 3"
Profit	$ 22,402.20	13.04%	$ 0.90	
Total Cost	$ 171,750.24	100%	$ 6.87	



Select the "Copy as Option 1" button from the Output spreadsheet and these results are copied to the Comparison Page spreadsheet as "Option 1."

4. Go back to the Input spreadsheet to repeat this process with the project constraint for *"percent deteriorated"* set to 30%. Continue to the output spreadsheet and select the "Copy as Option 2" button.

5. Repeat step five above by selecting a percent deteriorated of 40%. Then paste these results to the Comparison Page by selecting the "Copy as Option 3" button.

6. The Comparison page should now look like this:

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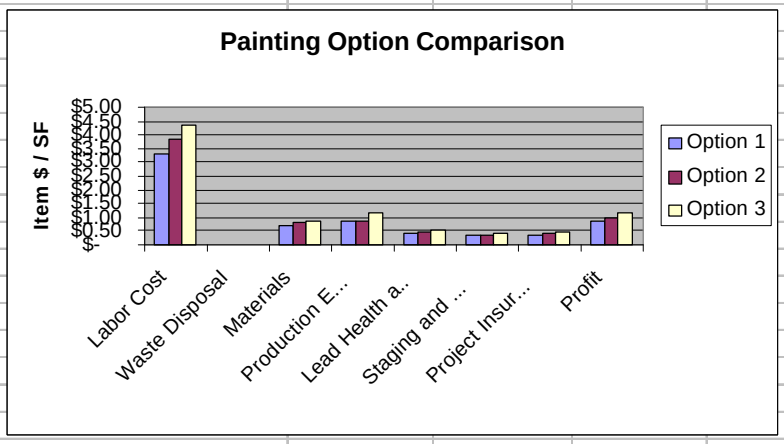
	Option 1	Option 2	Option 3
Labor Cost	$ 3.32	$ 3.84	$ 4.37
Waste Disposal	$ 0.01	$ 0.01	$ 0.02
Materials	$ 0.71	$ 0.80	$ 0.89
Production Equipment	$ 0.87	$ 0.87	$ 1.14
Lead Health and Safety	$ 0.40	$ 0.46	$ 0.51
Staging and Containment	$ 0.32	$ 0.32	$ 0.41
Project Insurance	$ 0.34	$ 0.38	$ 0.44
Profit	$ 0.90	$ 1.00	$ 1.17
Total Cost / SF	$ 6.87	$ 7.69	$ 8.94



7. Now go back to the Input spreadsheet and select the operating parameters (the painting options) for the coating replacement option. The selections should be as follows:

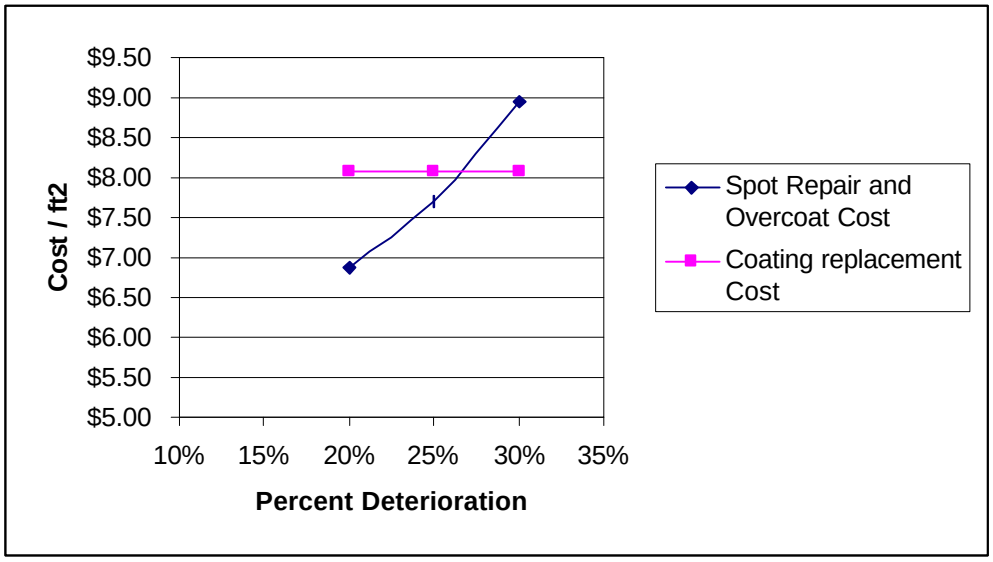
Category / Selection Area	Select this
Full Removal Surface Preparation	*1. Once Through Abrasive*
Spot-Sweep Surface Preparation	*0. Full Removal Preparation*
Staging/Containment Options	*1. Lift Trucks*
Coating System Options	*1. Three Coat System*
Coating Application Options	*4. Airless Spray*

8. View the cost model output on the Output spreadsheet. The result is an overall cost/ft^2 of $8.07. Note that this cost will change depending upon the production factors selected (colored cells of the Input Spreadsheet) and the Cost Variables (colored cells of the Cost Variables spreadsheet). Also, unlike the output for the overcoating option, this output will not be dependent upon the *"percent deteriorated."*

9. Our data now consists of the following:

Initial Coating Deterioration	***Spot Repair and Overcoat Cost***	***Coating Replacement Cost***
20%	$6.87	$8.07
25%	$7.69	$8.07
30%	$8.94	$8.07

Plotting this data on an Excel Spreadsheet, we see the following:



The lines cross at approximately 27% deterioration, so for levels of deterioration over 27% this analysis suggests that coating replacement is the painting option with the lower initial cost. Bear in mind that each of the options in this scenario also has technical merits and justifications that may sway the overall painting decision. For

example, if adhesion of the existing coating was extremely poor, one may choose coating replacement even if the deterioration was less than 27%.

EXAMPLE 2 – EXPENDABLE GRIT COMPARED TO RECYCLABLE STEEL GRIT

This situation compares the additional equipment investment costs of using recyclable steel grit for surface preparation to the additional waste disposal costs of using disposable abrasives. The analysis will be based on varying the size of the bridge while tracking the costs of the two options.

Item	Input
Bridge Square Footage	10,000
percent deteriorated	20.0%
Forman	1
Blaster/Painter	4
Helper	2
Average Labor Rate	$ 26.00
Hours/Day	8.0
Lead in coating	Yes
Washing	Yes
Dehumidification	No
Pretox	No
Blastox	No
Rapid Deployment	No
Stripe Coat	Yes

1. Use the Input spreadsheet to set up the project constraints (initial conditions) for this scenario. We have selected the example data shown at the right.

2. Further down the Input spreadsheet, select the operating parameters (the painting options) for the full coating removal with disposable abrasives option. We have chosen the following:

Category / Selection Area	Select this
Full Removal Surface Preparation	*1. Once Through Abrasive*
Spot-Sweep Surface Preparation	*0. Full Removal Preparation*
Staging/Containment Options	*1. Lift Trucks*
Coating System Options	*1. Three Coat System*
Coating Application Options	*4. Airless Spray*

3. View the cost model output on the Output spreadsheet. The result is an overall cost/ft^2 of $12.44. Note that this cost will change depending upon the production factors selected (colored cells of the Input Spreadsheet) and the Cost Variables (colored cells of the Cost Variables spreadsheet). Your output should be similar to that on the following page:

Cost Effective Alternate Methods for Steel Bridge Paint System Maintenance

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Cost Model Spreadsheet - Results Page

For a Bridge Project with:

10,000	Paintable Square Feet
20.0%	Percent Area Deteriorated
7	Persons in the Work Crew

The Costs to:

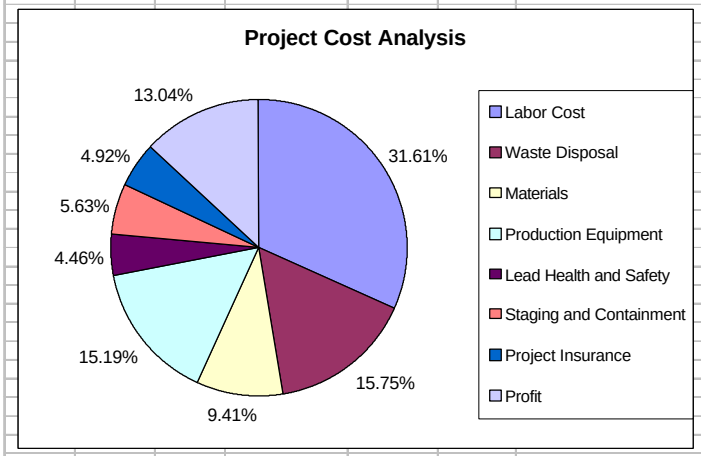
Contain the bridge using Lift Trucks

Perform full removal with once through abrasive

Airless spray apply a three coat system

are given below.

	Item Cost	Item Percentage	Cost / SF	Select below to send results to the "Comparison Page"
Labor Cost	$ 39,312.00	31.61%	$ 3.93	Copy as "Option 1"
Waste Disposal	$ 19,584.75	15.75%	$ 1.96	
Materials	$ 11,698.50	9.41%	$ 1.17	
Production Equipment	$ 18,890.25	15.19%	$ 1.89	Copy as "Option 2"
Lead Health and Safety	$ 5,550.00	4.46%	$ 0.56	
Staging and Containment	$ 7,002.58	5.63%	$ 0.70	
Project Insurance	$ 6,122.28	4.92%	$ 0.61	Copy as "Option 3"
Profit	$ 16,224.06	13.04%	$ 1.62	
Total Cost	$ 124,384.42	100%	$ 12.44	



4. Select the “Copy as Option 1” button from the Output spreadsheet and these results are copied to the Comparison Page spreadsheet as “Option 1.”

5. Go back to the Input spreadsheet to repeat this process with the operating parameters (the painting options) now set for the full coating removal with recyclable steel grit abrasives.

Category / Selection Area	Select this
Full Removal Surface Preparation	*3. Recyclable Steel Grit*
Spot-Sweep Surface Preparation	*0. Full Removal Preparation*
Staging/Containment Options	*1. Lift Trucks*
Coating System Options	*1. Three Coat System*
Coating Application Options	*4. Airless Spray*

6. Continue to the output spreadsheet and select the “Copy as Option 2” button. Then go back to the output spreadsheet and select the “Copy as Option 3” button. The Comparison page should now look like the following:

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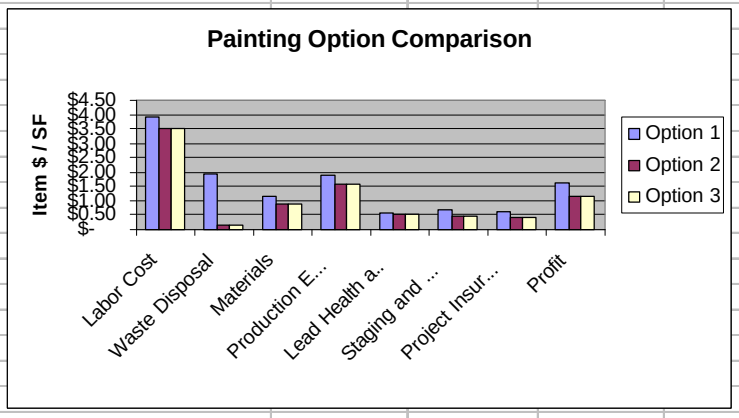
	Option 1	Option 2	Option 3
Labor Cost	$ 3.93	$ 3.49	$ 3.49
Waste Disposal	$ 1.96	$ 0.16	$ 0.16
Materials	$ 1.17	$ 0.87	$ 0.87
Production Equipment	$ 1.89	$ 1.59	$ 1.59
Lead Health and Safety	$ 0.56	$ 0.51	$ 0.51
Staging and Containment	$ 0.70	$ 0.48	$ 0.48
Project Insurance	$ 0.61	$ 0.43	$ 0.43
Profit	$ 1.62	$ 1.13	$ 1.13
Total Cost / SF	$ 12.44	$ 8.66	$ 8.66

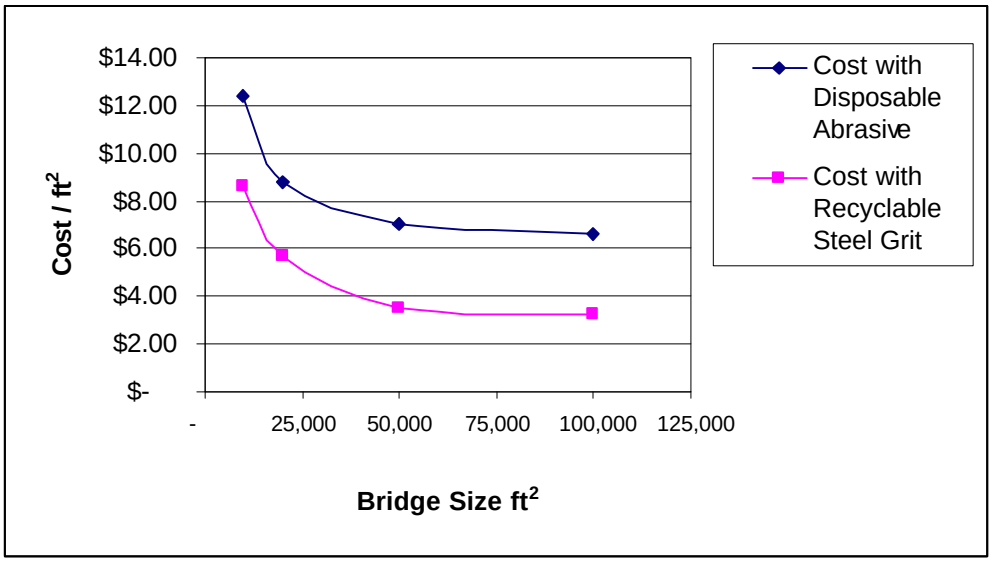


This graph provides a snapshot comparison between the disposable abrasive and the recyclable steel grit abrasive options for a bridge size of 10,000 ft^2.

7. If we continue this same analysis for both painting options, while increasing the bridge square footage, we can create the following data:

Bridge Size	***Cost with Disposable Abrasive***	***Cost with Recyclable Steel Grit***
10,000	$12.44	$8.66
20,000	$8.80	$5.68
50,000	$7.03	$3.53
100,000	$6.60	$3.25

8. If we plot this data we see the following:



This analysis shows an across the board savings with using recyclable steel grit. Because of the sensitivity of the various cost factors currently in the model, this may not always be true for actual projects. More important to notice in this plot is the fact that the relative difference between these two options gets larger as the size of the structure increases. The leads to the conclusion that on a larger project, there is an increased potential for cost savings using the recyclable steel grit equipment.

SUMMARY

Users are encouraged to develop their own comparison plots of the cost model output. In addition, by adjusting the "Cost Variables" to better match your particular area, the absolute values produced by the model will become more "realistic."