

CALIFORNIA LIFE-CYCLE BENEFIT/COST ANALYSIS MODEL (Cal-B/C Corridor)

INTRODUCTION

Cal-B/C Corridor is a post-processor, benefit-cost tool for preparing economic analyses of highway and transit projects. The model conducts benefit-cost analyses using the changes in vehicle-miles traveled (VMT) and vehicle-hours traveled (VHT), or person-miles traveled (PMT) and person-hours traveled (PHT), estimated in traffic and planning models. Cal-B/C Corridor is derived from the Cal-B/C Sketch model, but it has a flexible design to support a variety of inputs, including segment and speed bin data from regional travel demand and micro-simulation models. The Cal-B/C Corridor model uses the same assumptions and parameters and produces results fully comparable with Cal-B/C Sketch.

Provided that a project is already modeled in a traffic or planning model, Cal-B/C Corridor is able to calculate lifecycle costs, lifecycle benefits, net present value, benefit/cost ratio, internal rate of return, and payback period using appropriate input data. Five main categories of annual benefits are calculated directly within the model:

- Travel time savings (reduced travel time and new trips)
- Travel time reliability benefits (increased reliability of travel time)
- Vehicle operating cost savings (reduced fuel and non-fuel operating costs)
- Accident cost savings (reduced cost to society related to safety)
- Emission cost savings (air quality and greenhouse gas benefits).

The model is arranged by worksheets and contains the following information, data, and results:

Worksheets

Contents

Instructions

General model description and assumptions

1) Project Information

Basic project data, model setup, and project costs

2) Model Inputs

Traffic or planning model input data in terms of VMT, VHT, PMT, PHT, out-of-pocket costs, and crash rates

3) Results

Summary results of analysis

Travel Time

Calculation of travel time impacts

Consumer Surplus

Calculation of benefits for new trips that result from project implementation, which are reported with travel time benefits

Reliability

Calculation of travel time reliability benefits

Vehicle Operating Costs

Calculation of changes in highway vehicle operating costs

Accident Costs

Calculation of benefits resulting from improved safety

Emissions

Calculation of emissions impacts

Final Calculations

Calculation of net present value, internal rate of return, and payback period

Parameters

Economic assumptions, lookup tables, and other model parameters consistent with other Cal-B/C models

Cal-B/C Corridor is designed so that the user generally needs to insert data only in the **green boxes** (light gray when printed) on the Project Information and Model Inputs worksheets. Summary results are shown on the Results worksheet. The remaining worksheets are provided for the user to see, but the model performs calculations automatically.

In the process of economic analysis, some generally accepted economic assumptions are necessary. These assumptions include the real discount rate, unit user costs (e.g., value of time), consumption rates (e.g., fuel consumption and vehicle emissions), crash rates, and accident rates. These assumptions are given in the Parameters worksheet and should not be changed by the user.

After reading the instructions in this worksheet, the user should proceed to the Project Information worksheet and Model Inputs worksheet and input data for the specific project in the **green boxes** (light gray when printed). The model provides default values in the **red boxes** (medium gray when printed). These values can be changed by the user if information specific to the project is available. The model calculates some values based on relationships or assumptions, with results shown in the **blue boxes** (dark gray when printed). These values can be changed by the user.

INSTRUCTIONS

The user can analyze projects by entering data primarily in the Project Information and Model Inputs worksheets. These worksheets cover information regarding project characteristics, analysis inputs, traffic model data that drives the costs and benefits of infrastructure investments. The results are calculated automatically and displayed on the Results page. The section below explains the input data required to analyze projects.

PROJECT DATA (Box 1A)

This section provides general information about the highway or transit improvements. At the top of the Project Information sheet, the user can insert information about the improvements, such as the project name, Caltrans District, and funding information.

Project Location

- 1 Insert a 1, 2, or 3 for the appropriate region of California. This information is used to estimate the emissions benefits.

Project Timing

- 2 Enter the current year. All benefits and costs are discounted to the year entered in this cell.
- 3 Enter the year when construction begins. This should represent the first year of construction expenditures.
- 4 Enter the project opening year. This should represent the first year when economic benefits will begin accruing in the analysis.

MODEL STRUCTURE (Box 1B)

This section allows the user to customize Cal-B/C Corridor and specify the number of model groups, safety groups, reliability groups, and years to be included in the analysis. Once these have been selected, press "Create Model" button to save the model with the selected numbers of structure elements. If the user wishes to change the model structure (i.e., number of model groups or years), the user will need to start again from the beginning.

- 5 Enter the number of model groups to be analyzed. Cal B/C Corridor is flexible so model groups can be defined by several classifications including time-of-day, vehicle type, trip purpose, section of roadway, roadway classification, or speed bin. For example, defining data by 1-mph speed bins would require about 70 model groups. If these were defined separately for automobiles and trucks, then about 140 model groups would be needed. For most applications, 100 to 200 model groups will be adequate. The model will accommodate a maximum of 500 model groups.
- 6 Enter the number of safety groups to be analyzed. By default, this number is set to be equal to the number of model groups. However, the value in this cell can be set to a different number of safety groups, depending on the structure of safety data available to the user. For example, safety groups could be defined by segment, road classification, or mode.
- 7 Enter the number of reliability groups to be analyzed. By default, this number is set to be equal to the number of model groups. However, the value in this cell can be set to a different number of reliability groups, depending on the structure of reliability data available to the user. Reliability groups should be defined based on where travel time reliability conditions are similar. This could be a segment, corridor, subarea, or network.
- 8 Enter the number of years in the analysis period. Lifecycle benefits will be calculated for the total number of years specified. The results displayed on the Results worksheet are representative of the total benefits for all model groups over the years in the analysis period. The model will handle a maximum of 50 years.
- 9 Click the 'Create Model' button to generate a version of the Cal-B/C Corridor model with the number of model groups and years specified. A new model must be generated to make any future adjustments to the number of model groups, safety groups, reliability groups, or the length of the analysis period.

PROJECT COSTS (Box 1C)

Net project costs should be inserted in the years they are expected to occur. Costs should be inserted for the construction period and the operating period (specified in the Model Structure) after construction completion. The box will automatically label years according to the construction start year provided by the user in the Project Data box. All costs should be inserted in thousands of dollars.

- 10 Enter the project's initial costs in constant dollars consistent with the current year entered in Box 1A. Costs should be entered for project support, right-of-way, and construction. Costs should be entered for each year of construction. The model is set up for 8 years of construction, but costs should be entered only for the number of years defined in Box 1A. If less than 8 years of construction are selected, the years may overlap with the Project Costs.
- 11 Enter estimated future incremental maintenance/operating and rehabilitation costs in constant dollars. These figures should be entered for all years after the project opens.
- 12 Enter any estimated mitigation costs or transit agency cost savings in constant dollars during construction and during the operating period after construction completion.
- 13 Insert any other costs not already included.

DEFINITION OF MODEL GROUPS AND YEARS (Box 2A)

The Model Inputs page allows the user to define the data available from a traffic or planning model and enter that data. In Box 2A, the user defines the model groups to be used in the analysis and identifies the base and forecast years for the traffic or planning model available.

- 14 Select the mode for each model group from the following options: Bus, Passenger Train, Light Rail, and Highway.
- 15 Provide a name and description for each model group. The name is a short “nickname” that will appear on subsequent tables in the model. The description column allows the user to define the model group in more detail than provided by the name. Both of these entries are optional.
- 16 For Highway mode, enter the average vehicle occupancy (AVO) for each model group. This AVO will be copied automatically to the aggregate model data in Boxes 2C and 2D, but the user can change the AVO if necessary. For example, the AVO may change between the base year and forecast year or from the No Build scenario to the Build scenario. For other modes, AVO information is not used in further calculations.
- 17 For Highway mode, if automobile and truck data are combined, enter the percentage of trucks in the total traffic. If automobile and truck data are entered separately in more than one model group, the percent trucks can be set to 0 percent and 100 percent as appropriate. Like the AVO data, this information will be copied automatically to the aggregate model data in Boxes 2C and 2D, but it can be changed. For other modes, the percentage of trucks information is not used in further calculations.
- 18 Enter the base year and forecast year of the traffic model outputs. In the analysis, the model will automatically interpolate data to estimate benefits for interim years.

AVERAGE PROFILE FOR DIVERTED TRIPS/INDUCED TRIPS (Box 2B)

For every Transit model group (a model group for a mode other than Highway), the user must determine whether the mode exists in the No Build scenario. If the mode does not exist, the user must enter the parameters for the least cost alternative to that mode in Box 2B. The user must input data on average speed and average trip length for the years selected in Box 2A. These parameters are different for diverted and induced trips. If a Highway mode is selected in Box 2A or the Transit mode exists in the Build scenario (based on data entered in Boxes 2C and 2D), the average profile for diverted trips/induced trips data are not required and the appropriate cells in Box 2B will be grayed out.

- 19 Enter average speed for diverted trips in the base year specified in Box 2A. Enter average trip length for diverted trips in the base year. Enter average speed for diverted trips in the forecast year specified in Box 2A. Enter average trip length for diverted trips in the forecast year.
- 20 Enter average speed for induced trips in the base year. Enter average trip length for induced trips in the base year. Enter average speed for induced trips in the forecast year. Enter average trip length for induced trips in the forecast year.

AGGREGATE MODEL DATA (Boxes 2C and 2D)

The user enters output from a traffic or planning model (i.e., microsimulation or travel demand model) in Boxes 2C and 2D. The inputs required for Highway and Transit modes are different.

For Highway model groups, the user needs to enter only VMT and VHT data. Vehicle speeds are calculated automatically from this information. The number of trips can be entered for induced demand calculations or ignored. The user should check AVO and percent truck information, which is copied automatically from Box 2A.

For Transit model groups (Bus, Passenger Train, and Light Rail), another set of inputs is required. The number of trips is very important for the calculations to work. If a mode is not included in the No Build, then pay special attention to Box 2B inputs.

- 21 For Highway model groups, enter the total daily VMT and VHT in the No Build and Build scenarios for each model group. For Transit model groups, enter the total daily PMT and PHT in the No Build and Build scenarios for each model group. These values should be entered for the base and forecast year specified earlier. Boxes 2C and 2D will be labeled with the appropriate years. Additionally, any out-of-pocket costs are entered in these boxes.
- 22 For Highway model groups, the AVO and Percent Trucks specified for each model group in Box 2A are also populated in Boxes 2C and 2D. These should be changed only if they vary from the base year to the forecast year or from the No Build scenario to the Build scenario.
- 23 The user can also enter trip data. For Highway model groups, this information is required to estimate induced demand. If the trip data are not entered, the model calculates benefits without induced demand. The detailed tables for travel time calculations will list the number of trips as 1 (if trip data are not entered), but this does not affect the calculations and should not be changed. For Transit model groups, the number of trips is required in the No Build and Build scenarios.
- 24 While filling out the tables, keep in mind that for Highway model groups, Trips and VMT refer to vehicle trips and vehicle-miles traveled. For Transit Groups, Trips and VMT refer to person (transit) trips and transit vehicle-miles traveled.

DEFINITIONS OF SAFETY GROUPS AND YEARS (Box 2E)

In Box 2E (similar to Box 2A), the user defines the safety groups to be used in the analysis and identifies the base and forecast years for the safety data.

- 25 Select the mode for each safety group from the following options: Bus, Passenger Train, Light Rail, and Highway.
- 26 Provide a name and description for each safety group. The name is a short “nickname” that will appear on subsequent safety tables in the model. The description column allows the user to define the model group in more detail than provided by the name.
- 27 For Highway safety groups, enter reduction factors that indicate the percentage by which crash rates decrease from the No Build scenario to the Build scenario. The factors may be different for fatal, injury, and property damage only crashes. The user is not required to enter reduction factors for Bus, Passenger Train, and Light Rail modes.

SAFETY DATA (Boxes 2F and 2G)

The user enters data needed to calculate safety benefits into this box. Data needs are different for Highway safety groups and Transit (Bus, Passenger Train, and Light Rail) safety groups.

- 28 For Highway safety groups, enter VMT and crash rates per million VMT for each severity of crashes.
- 29 For Transit safety groups, only enter transit vehicles miles traveled (VMT). The number of accident events will be estimated automatically using standard values in the Parameters worksheet. In these values need to be modified, the user must go to the Parameters worksheet.

DEFINITIONS OF RELIABILITY GROUPS AND YEARS (Box 2H)

In Box 2H (similar to Boxes 2A and 2E), the user defines the reliability groups to be used in the analysis and identifies the base and forecast years for the reliability data. Reliability groups should be defined according to areas that are expected to have similar travel time reliability or impacted by similar reliability factors. Examples include segments, corridors, subareas, or an entire model.

- 30 Provide a name and description for each reliability group. The name is a short “nickname” that will appear on subsequent tables in the model. The description column allows the user to define the model group in more detail than provided by the name.
- 31 Provide the duration (in hours) of traffic for each reliability group, and background in the Build and No Build scenarios, as well as roadway length, number of lanes, free-flow speed, and average vehicle occupancy.

RELIABILITY DATA (Boxes 2I and 2J)

The user enters data needed to calculate travel time reliability benefits into this box.

- 32 Provide the vehicle-hours traveled and the percent of truck traffic for each reliability group in the No Build and Build scenarios. The user enters this data for the base year and forecast periods.

TRAVEL TIME RELIABILITY (Box 2K)

The model estimates the standard deviation of travel time using general relationships and data entered in the model. The user may adjust the standard deviations of travel time for automobiles and trucks in each reliability group by entering an adjustment factor.

- 33 Adjustment factors are calculated as the ratio of the standard deviations calculated by the model to the standard deviation changes entered by the user. The user may override the adjustment factors to scale the standard deviations calculated.

Next Steps

Once the required values are entered into the Project Information and Model Inputs worksheets, the aggregate results of the analysis are automatically compiled on the Results worksheet. This worksheet includes toggles for adding and removing benefits from the calculations, including induced trips, traveled time reliability, vehicle operating cost savings, accident cost savings, and emissions cost savings. A more detailed breakdown of the results by year and benefit type is available on the Final Calculations worksheet.

There is also a Parameters worksheet, identical to the one found in other Cal-B/C models. Since Cal-B/C Sketch requires more operational parameters for its sketch planning methods and other Cal-B/C tools require specialized parameters, several of the values found on the Parameters worksheet are not used in Cal-B/C Corridor. This design is intentional, so the same Parameters worksheet can be used in all models. A few cells (e.g., project type) are left blank to avoid Excel error messages. On the Parameters page, the user can change economic values and the annualization factor to match traffic or planning model data.