Using the New Roadside Safety Analysis Program (RSAPv3)

Malcolm H. Ray, P.E., Ph.D.
Christine Carrigan, P.E., Ph.D.
Chuck Plaxico, Ph.D.
Let’s introduce ourselves...
What does RSAPv3 do and how does it do it?
How do we decide what the best roadside safety treatment at a particular site?

- Example – let’s say we have a divided highway.
  - What is the best median barrier to use?
  - What does *best* mean?

The roadside treatment that gives the largest crash cost reduction for the money invested to construct and maintain the treatment.
How do we decide what the best roadside safety treatment is at a particular site?

- Options:
  - No median barrier.
  - Cable median barrier.
  - W-beam median barrier.
  - TL4 concrete median barrier.
  - TL5 concrete median barrier.
How do we decide what the best roadside safety treatment is at a particular site?

- Options:
  - No median barrier.
  - Cable median barrier.
  - W-beam median barrier.
  - TL4 concrete median barrier.
  - TL5 concrete median barrier.

BENEFIT COST RATIO

\[ BCR = \frac{\text{Reduction in crash costs}}{\text{Cost of the Improvement}} \]

RSAPv3 calculates and ranks the BCR of alternatives to find the “best” roadside treatment option.
Encroachment-Based Benefit-Cost Methods have a long history in Roadside Safety

1977 Barrier Guide hand-calculation method

1989 BCAP

1994 ABC

1998 RSAP 1.0.0

2002 RSAP 2.0.3

NCHRP 22–27 completely updated the algorithms and rewrote RSAP
Where can I get RSAPv3?

http://www.rsap.roadsafellc.com/

RSAP v 3.0.0 Download Page

RSAP v 3.0.0 (Release 121024)

RSAP Information
- User Manual
- Engineer’s Manual
- Programmer’s Manual
- TR News Article about RSAPv3
  (posted with permission of NAS TRB)

Requirements
RSAPv3 is written as a series of Microsoft Excel macros. RSAPv3 will run on any Windows computer running Excel 14 or better and will run on both 32 and 64 bit computers. RSAPv3 has been successfully tested with Windows 7, Windows XP and Vista.

Resources
- Go to the RSAP Support Facebook page for questions and answers.
- See the Release Notes
- Installation Tips
  - Tip #1 — Disable warnings when downloading using the “Install from Web” button.
  - Tip #2 — Security message when opening the workbook for the first time.
  - Tip #3 — I don’t have administrative privileges on my computer. Can I still install RSAP?

Example Case Workbooks
These are the Excel macro-enabled workbooks for the cases described in the User’s Manual. It may take some time to open up Excel over the internet so you should save these locally and open them on your computer.
- NITA Concrete Median Barrier
- WSDOT Cable Median Barrier
- RDG Culvert Example

User Submitted Examples
If you have an example that you would like to share, please email it to the project team using the button at the top of the page. We will post it here.
RSAPv3 is actually a group of Excel Macros → Excel must be installed on your computer.
Current release is RSAP 3.0.1 release 130304.
Release 121024 and later run on either 32 or 64 bit computers.
Same code runs on both architectures regardless of whether you have the 32 or 64 bit version of excel installed.
If you have Excel 12 (i.e., Windows 2007) you need a slightly different version → contact the development team.
Register your copy so you are notified about updates, changes and training opportunities.
Remember:
Enable editing after download
Example Problem

Median Barrier Alternatives on a High-Speed, High-Volume Divided Highway

Christine E. Carrigan, P.E., Ph.D.
### RSAP PROJECT INFORMATION

#### BASIC INFORMATION

- **Title**: Concrete Barrier Example Problem

#### Unit Information

<table>
<thead>
<tr>
<th>Units</th>
<th>Value 1</th>
<th>Value 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>USCU</td>
<td>25 YRS</td>
<td>2003</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td></td>
</tr>
</tbody>
</table>

**Notes**: See User’s Manual Page 85 for a description of this example problem.

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**Microsoft Excel Warning**

The cell or chart that you are trying to change is protected and therefore read-only. To modify a protected cell or chart, first remove protection using the Unprotect Sheet command (Review tab, Changes group). You may be prompted for a password.

---

**Note**: Each term and input cell is defined in the User’s Manual.
RSAP Controls
  ◦ Always on the left side of screen.
  ◦ Work flows from:
    • Top to bottom
    • Left to right
  ◦ Correspond to each worksheet.
  ◦ Button options change with the context of the worksheet.
  ◦ Hints about what to do next.
  ◦ General purpose buttons – available all the time.
Our Focus: Example Problem

- Entry of Project Data
  - Traffic characteristics
  - Highway types
  - Highway characteristics
  - Properly locating data
  - Roadside cross-section

- Analysis Settings

- Results
### Concrete Barrier Example Problem

#### TRAFFIC INFORMATION

<table>
<thead>
<tr>
<th>Construction Year ADT:</th>
<th>47,700 vehicles/day</th>
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</thead>
<tbody>
<tr>
<td>Traffic Growth:</td>
<td>1.7% growth/yr</td>
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<tr>
<td>Mid-Life ADT:</td>
<td>58,888 vehicles/day</td>
</tr>
<tr>
<td>End Of Life ADT:</td>
<td>72,701 vehicles/day</td>
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<tr>
<td>ADT Used By RSAP</td>
<td>58,888 vehicles/day</td>
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</table>

#### VEHICLE MIX

<table>
<thead>
<tr>
<th>FHWA Class</th>
<th>Percent</th>
<th>RSAP Type</th>
<th>Weight</th>
<th>Length</th>
<th>Width</th>
<th>C.G. Long.</th>
<th>C.G. Hgt.</th>
<th>Crash Cost Adj.</th>
<th>Encr Multiplier</th>
<th>Mix Multiplier</th>
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</thead>
<tbody>
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<td>M</td>
<td>600</td>
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<td>1.50</td>
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<td>1.00</td>
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<td>5.40</td>
<td>6.00</td>
<td>2.20</td>
<td>1.00</td>
<td>1.00</td>
<td>-0.15</td>
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<tr>
<td>3</td>
<td>21.3</td>
<td>PU</td>
<td>5,000</td>
<td>19.75</td>
<td>6.50</td>
<td>8.00</td>
<td>2.00</td>
<td>1.00</td>
<td>1.00</td>
<td>0.15</td>
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<tr>
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<td>17.00</td>
<td>8.50</td>
<td>20.00</td>
<td>4.8</td>
<td>3.52</td>
<td>0.30</td>
<td>0.00</td>
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<tr>
<td>5</td>
<td>0.0</td>
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<td>37,500</td>
<td>18.00</td>
<td>8.50</td>
<td>20.00</td>
<td>4.8</td>
<td>3.52</td>
<td>0.30</td>
<td>0.00</td>
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<tr>
<td>6</td>
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<td>6,800</td>
<td>15.00</td>
<td>7.77</td>
<td>12.50</td>
<td>3.4</td>
<td>3.52</td>
<td>0.30</td>
<td>0.00</td>
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<tr>
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<td>ASUT</td>
<td>12,000</td>
<td>15.00</td>
<td>7.77</td>
<td>12.50</td>
<td>3.4</td>
<td>3.52</td>
<td>0.30</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Enter the average annual daily traffic as a whole number.
Concrete Barrier Example Problem

WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION: 50%
PERCENT OF TRAFFIC ENCR OACHING RIGHT: 50%
HIGHWAY TYPE: D
TERRAIN: F
POSTED SPEED LIMIT: 65 mi/hr
USER ENR OACHMENT ADJUSTMENT: 1

PROJECT LIMITS

Min Sta: 0.000 ft
Min Sta: 52+80.00 ft
Max Offset: 200.00 ft

EXPECTED PASSENGER VEHICLE ENCR OACHMENTS

ROAD SEGMENT DATA

TOTAL

SEG | START STA | END STA | SEGMENT LENGTH | BASE ENC RATE | MODIFIED ENC RATE | PRIMARY Directive | PRIMARY LEFT ENC RATE | OPPOSING Directive | OPPOSING LEFT ENC RATE | TOTAL ENC RATE |
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
1 | 0.000 | 52+80.0 | 5,280.00 | 10.1948 | 10.1948 | 2.5487 | 2.5487 | 2.5487 | 2.5487 | 2.5487

EXPECTED TRUCK ENCR OACHMENTS
Highway Types

- Undivided
- Divided
- One way
RSAPv3 includes many dropdown menus that provide the appropriate input options.
Highway Characteristics: prm_curv_rad (feet)

0+00 to 30+00  -1000
30+00 to 45+00  T
45+00 to 52+80  +1000
Highway Characteristics: prm_grade (percent)

INCREASING STATION (i.e., primary direction)

Negative Grade

Positive Grade

0+00 to 20+00 -2
20+00 to 52+80 +2
Concrete Barrier Example Problem

WHOLE ROADWAY CHARACTERISTICS

PERCENT OF TRAFFIC IN PRIMARY DIRECTION:
50%

PERCENT OF TRAFFIC ENCROACHING RIGHT:
50%

HIGHWAY TYPE:
D

TERRAIN:
F

POSTED SPEED LIMIT:
65 mi/hr

USER ENROACHMENT ADJUSTMENT:
1

USER-ENTERED CHARACTERISTICS

<table>
<thead>
<tr>
<th>START STATION</th>
<th>END STATION</th>
<th>KEYWORD</th>
<th>VALUE</th>
<th>SEG.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0+00.</td>
<td>52+80.</td>
<td>Lanes Total</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>0+00.</td>
<td>52+80.</td>
<td>PRM_NUM_LNS</td>
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<td></td>
</tr>
<tr>
<td>0+00.</td>
<td>52+80.</td>
<td>Med_Width</td>
<td>27</td>
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</tbody>
</table>

RSAP DEFAULT HIGHWAY CHARACTERISTICS

<table>
<thead>
<tr>
<th>DIVIDED HIGHWAYS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Density</td>
</tr>
<tr>
<td>Lanes Total</td>
</tr>
<tr>
<td>LnWidth</td>
</tr>
<tr>
<td>Med_Width</td>
</tr>
<tr>
<td>Med_Shlr_Width</td>
</tr>
<tr>
<td>Prm_Curv_Rad</td>
</tr>
<tr>
<td>Prm_Grade</td>
</tr>
<tr>
<td>Prm_Num_Lns</td>
</tr>
<tr>
<td>Rmblstrip</td>
</tr>
<tr>
<td>Rt_Shlr_Width</td>
</tr>
</tbody>
</table>
### Concrete Barrier Example Problem

**WHOLE ROADWAY CHARACTERISTICS**

- **Percent of Traffic in Primary Direction:** 50%
- **Percent of Traffic Encroaching Right:** 50%
- **Highway Type:** F
- **Terrain:** 65 mi/hr
- **Posted Speed Limit:**
- **User Enroachment Adjustment:**

<table>
<thead>
<tr>
<th>PROJECT LIMITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Sta</td>
</tr>
<tr>
<td>Max Sta</td>
</tr>
<tr>
<td>Max Offset</td>
</tr>
</tbody>
</table>

### ROAD CHARACTERISTICS TABLE

<table>
<thead>
<tr>
<th>SEG</th>
<th>STATIONS</th>
<th>ADT</th>
<th>SPEED LIMIT</th>
<th>TERRAIN</th>
<th>TOTAL NUMBER OF LANES</th>
<th>PRIM DIR GRADE</th>
<th>PRIM DIR CURVE RADIUS</th>
<th>LNS IN PRIM DIR</th>
<th>MEDIAN WIDTH</th>
<th>MEDIAN SHDLR WIDTH</th>
<th>LANE WIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5888</td>
<td>65 mi/hr</td>
<td>F</td>
<td>4</td>
<td>0</td>
<td>T</td>
<td>2</td>
<td>30</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>START</td>
<td>0+00</td>
<td>52+80.00</td>
<td>5888</td>
<td>65</td>
<td>0</td>
<td>T</td>
<td>2</td>
<td>27</td>
<td>10</td>
<td>12</td>
</tr>
</tbody>
</table>

*Enter the road characteristics in the yellow cells. When finished select Segment Project.*
RSAPv3 will evaluate up to five alternatives with up to 25 segments at one time.

Enter from lowest to highest construction cost.

- Alternative 1: Unprotected median
- Alternative 2: W-beam median
- Alternative 3: TL-3+ concrete median
- Alternative 4: TL5 NJ Shape median
Baseline at center of a divided highway.
Concrete median offset = 0’
Concrete median width = 32”
Median edge offset = 13.5’L and 13.5’R
Menu options are context sensitive. Most input cells include error checking and will notify you if you enter invalid information.
<table>
<thead>
<tr>
<th>GENERAL HAZARD TYPE</th>
<th>SPECIFIC HAZARD TYPE</th>
<th>START STATION</th>
<th>START SIDE</th>
<th>START OFFSET</th>
<th>END STATION</th>
<th>END SIDE</th>
<th>END OFFSET</th>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>SpecialEdge</td>
<td>EdgeOfMedian</td>
<td>0+00.</td>
<td>R</td>
<td>13.5</td>
<td>52+80.00</td>
<td>R</td>
<td>13.5</td>
<td>Width (in.)</td>
<td>24</td>
</tr>
<tr>
<td>MedianBarriers_SemiRigid</td>
<td>WBeam</td>
<td>0+00.</td>
<td>L</td>
<td>0</td>
<td>52+80.00</td>
<td>L</td>
<td>0</td>
<td>Width (in.)</td>
<td>24</td>
</tr>
</tbody>
</table>

Options for General Hazard Type:
- Guardrails_Rigid
- Guardrails_SemiRigid
- MedianBarriers_Flexible
- MedianBarriers_Rigid
- MedianBarriers_SemiRigid
- PoleTreeSign
- SpecialEdge
- TerminalEnds

Options for Specific Hazard Type:
- WBeam
- TL3

Notes:
- Complete the information in the yellow cells.
- Use buttons to add, edit or delete alternatives.
### RSAP Controls

**PROJECT**
- 4 ALTS DEFINED
- Clear All Alternative Data
- Copy Alt 1
- Delete Alt 2

**TRAFFIC**
- Copy Alt 1

**HIGHWAY**
- Copy Alt 1

**ALTERNATIVES**
- Copy Alt 1

**X-SECTION**
- Copy Alt 1

**ANALYZE**
- View/Edit Alternative 1
- View/Edit Alternative 2
- View/Edit Alternative 3
- View/Edit Alternative 4

**RESULTS**
- Hazard Info >
- < Highway Info

**SETTINGS**
- User's Manual
- Engineer's Manual
- Help
- Save
- Save As
- Exit

### RSAPv3_130304_concrete.xlsm

<table>
<thead>
<tr>
<th>ALTERNATIVE NAME</th>
<th>SPECIFIC HAZARD TYPE</th>
<th>START STATION</th>
<th>START SIDE</th>
<th>START OFFSET</th>
<th>END STATION</th>
<th>ENDSIDE</th>
<th>END OFFSET</th>
<th>PARAMETER</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL5 NJ Shape Barrier</td>
<td>EdgeOfMedian</td>
<td>0+00. R</td>
<td>13.5</td>
<td>52+80.00 R</td>
<td>13.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SpecialEdge</td>
<td>EdgeOfMedian</td>
<td>0+00. L</td>
<td>13.5</td>
<td>52+80.00 L</td>
<td>13.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MedianBarriers_Rigid</td>
<td>TL5NJshapeMB</td>
<td>0+00. L</td>
<td>0</td>
<td>52+80.00 L</td>
<td>0 Width (in.)</td>
<td>32</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Locating Data

- **Station** → Measured longitudinally in Stations in the Primary Direction.
- **Offset** → Measured as a distance left or right from the BASELINE.
- The baseline is different for different highway types.

*4 LANE DIVIDED*

The baseline runs along the center-line of the median in the direction of increasing stationing. All objects are located as being a distance to the left or right of the base line.
Locating Data

- **Station** → Measured longitudinally in Stations in the Primary Direction.
- **Offset** → Measured as a distance left or right from the BASELINE.

2 LANE UNDIVIDED

The baseline runs along the center-line of the undivided highway in the direction of increasing stationing. All objects are located as being a distance to the left or right of the base line.
Locating Data

- **Station** → Measured longitudinally in Stations in the Primary Direction.
- **Offset** → Measured as a distance left or right from the BASELINE.

The baseline runs along the left lane edge of the one-way road in the direction of increasing stationing. All objects are located as being a distance to the left or right of the base line. Use one-way roads for ramps or divided highways with independent alignments.
Locating Hazards

Offset 28 ft from the baseline to the pole.
Locating hazards

W-beam hazard with begin and end station and offset.

Offset 20 feet right from the baseline to the terminal hazard.

Note: Terminal length-of-need defined as w-beam hazard.
Locating Hazards
Baseline is always in middle of road
Provide a title for each alternative and the construction cost.

Choose one of the default cross-sections. These can be changed and modified on the next worksheet.
Roadside X-Sections
You can choose a different cross-section for each segment in each alternative.

You can also create your own new custom cross-sections and save them in the database.
Analysis and Results

Median Barrier Alternatives

Malcolm H. Ray, PE, PhD
ANALYZE:
How do I pick the best analysis settings?
Minimum and Maximum number of trajectories to select.

Select which encroachments you want to include in the analysis.

Outside scope of this course.
- Distance between encroachment locations.
- Default value is 4 ft.
- If you have point hazards you need a small number like 4 ft to make sure you don’t miss any hazards.
- 1000 ft works well when considering longitudinal hazards like our example problem.

\[
D = D_H + W_v 
\]

Radius of Hazard, \( r_H \)

\( \approx 5.4 \) ft
Encroachments to consider.
Encroachments Divided Highways

- Opposing Right Encroachments
- Opposing Left
- Primary Left
- Primary Right Encroachments
- Primary Direction
- Opposing Direction

Lateral Offset from Median Center-Line (ft):

- 36
- 24
- 12
- 0
- 12
- 24
- 36
Encroachments
Undivided Highways

Opposing Right Encroachments

Primary Right Encroachments

Opposing Direction

Primary Left

Opposing Left

Primary Direction

Lateral Offset from Center-Line (ft)
Encroachments
One-Way Highways

Primary Left
Primary Right Departures

Primary Direction

Lateral Offset from Left Edge-Line (ft)
- Only check the boxes for encroachments that you want to consider.
- Our example is evaluating a median barrier so we will consider only:
  - primary left and
  - opposing left.
Selecting RUN starts the analysis.

A progress bar will appear during the run to let you know how the run is progressing.
FEATURE COLLISION AND COST REPORT

Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

RSAP Settings: Min No. Traj=10; Max No. Traj=40; Traj Increment=1000 ft

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Segment</th>
<th>Feature Number</th>
<th>Feature Type</th>
<th>Encroachment Type</th>
<th>Total Feature Crashes</th>
<th>Penetrated or Vaulted</th>
<th>Rolled Over after Redirection</th>
<th>Annual Feature Crash Cost</th>
<th>Feature Maintenance Cost</th>
<th>Feature Repair Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1 EdgeOfMedian</td>
<td>PL</td>
<td></td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
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<td>1</td>
<td>1 EdgeOfMedian</td>
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<td>$43,287</td>
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<td>$0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2 EdgeOfMedian</td>
<td>OL</td>
<td></td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3 TL3WbeamMB</td>
<td>PL</td>
<td></td>
<td>1.9136</td>
<td>0.1481</td>
<td>0.0324</td>
<td>$45,443</td>
<td>$0</td>
<td>$2,296</td>
</tr>
</tbody>
</table>
What do all those numbers in the incremental cost–benefit table mean?
# Equivalent Annual Incremental Benefit-Cost

## Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

**RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01**

<table>
<thead>
<tr>
<th>Decision Point Benefit-Cost Ratio:</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alternative Choice</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>With Respect to Alternative</th>
<th>Alternatives</th>
<th>Unprotected Median</th>
<th>W-Beam Median Barrier</th>
<th>TL3+ NJ Shape Barrier</th>
<th>TL5 NJ Shape Barrier</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unprotected Median</td>
<td>1.00</td>
<td>11.80</td>
<td>11.49</td>
<td>8.18</td>
</tr>
<tr>
<td>2</td>
<td>W-Beam Median Barrier</td>
<td>0.00</td>
<td>10.58</td>
<td>4.70</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>TL3+ NJ Shape Barrier</td>
<td>0.00</td>
<td></td>
<td>1.91</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>TL5 NJ Shape Barrier</td>
<td></td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Best Choice is:** TL5 NJ Shape Barrier
# The Challenger–Defender Game

<table>
<thead>
<tr>
<th>Decision Point Benefit-Cost Ratio:</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alternative Choice</strong></td>
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</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>ALTERNATIVES</td>
<td></td>
</tr>
<tr>
<td>1 Unprotected Median</td>
<td>1.00</td>
</tr>
<tr>
<td>2 W-Beam Median Barrier</td>
<td>0.00</td>
</tr>
<tr>
<td>3 TL3+ NJ Shape Barrier</td>
<td>0.00</td>
</tr>
<tr>
<td>4 TL5 NJ Shape Barrier</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Defender**

**Challenger**
The Challenger–Defender Game

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</tr>
</thead>
<tbody>
<tr>
<td>Alternative Choice</td>
<td>1</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>--</td>
</tr>
<tr>
<td>With Respect to Alternative</td>
<td></td>
</tr>
<tr>
<td>ALTERNATIVES</td>
<td></td>
</tr>
<tr>
<td>1 Unprotected Median</td>
<td>1.00</td>
</tr>
<tr>
<td>2 W-Beam Median Barrier</td>
<td>0.00</td>
</tr>
<tr>
<td>3 TL3+ NJ Shape Barrier</td>
<td>0.00</td>
</tr>
<tr>
<td>4 TL5 NJ Shape Barrier</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Defender: 11.80
Challenger: 10.58 > 1
## The Challenger–Defender Game

<table>
<thead>
<tr>
<th>With Respect to Alternative</th>
<th>ALTERNATIVES</th>
<th>Unprotected Median</th>
<th>W-Beam Median Barrier</th>
<th>TL3+ NJ Shape Barrier</th>
<th>TL5 NJ Shape Barrier</th>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>TL5 NJ Shape Barrier</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision Point Benefit-Cost Ratio:** 1

- **Defender**: 10.58
- **Challenger**: 1.91 > 1
## Equivalent Annual Incremental Benefit-Cost

### Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01

<table>
<thead>
<tr>
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</thead>
<tbody>
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<td>1</td>
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</tr>
<tr>
<td>2 W-Beam Median Barrier</td>
<td>0.00</td>
</tr>
<tr>
<td>3 TL3+ NJ Shape Barrier</td>
<td>0.00</td>
</tr>
<tr>
<td>4 TL5 NJ Shape Barrier</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Best Choice is: **TL5 NJ Shape Barrier**
# SEGMENT AND ALTERNATIVE COST SUMMARY

Concrete Barrier Example Problem

Based on Analysis Run on 3/6/2013 8:35:50 AM

`RSAP 3.0.1 (release 130304) running in Excel Version 14.0 on Windows (32-bit) NT 6.01`

<table>
<thead>
<tr>
<th>Rate of Return</th>
<th>4</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design Life</td>
<td>25</td>
<td>yrs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>A/P</th>
<th>0.0640</th>
</tr>
</thead>
</table>

## ANNUAL SEGMENT SUMMARY

<table>
<thead>
<tr>
<th>Segment</th>
<th>Crashes</th>
<th>Crash Costs</th>
<th>Maintenance Cost</th>
<th>Repair Costs</th>
<th>Alternative</th>
<th>Annualized Construction Cost</th>
<th>Annual Maintenance Cost</th>
<th>Annual Repair Cost</th>
<th>Annual Crash Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Alternative1</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$453,393</td>
</tr>
<tr>
<td>1</td>
<td>3.60</td>
<td>$453,393</td>
<td>$0</td>
<td></td>
<td>Alternative2</td>
<td>$18,044</td>
<td>$500</td>
<td>$4,524</td>
<td>$181,294</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Alternative3</td>
<td>$30,369</td>
<td>$4,524</td>
<td>$377</td>
<td>$100,035</td>
</tr>
<tr>
<td>1</td>
<td>4.14</td>
<td>$181,294</td>
<td>$4,524</td>
<td></td>
<td>Alternative4</td>
<td>$46,583</td>
<td>$0</td>
<td>$377</td>
<td>$69,057</td>
</tr>
<tr>
<td></td>
<td>3.97</td>
<td>$100,035</td>
<td></td>
<td>$377</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.84</td>
<td>$69,057</td>
<td></td>
<td>$377</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
RSAP v 3.0.0 Download Page

**RSAP v 3.0.0 (Release 121024)**

**RSAP Information**
- User Manual
- Engineer’s Manual
- Programmer’s Manual
- TR News Article about RSAPv3 (posted with permission of NASA/TRB)

**Example Case Workbooks**
These are the Excel macro-enabled workbooks for the cases described in the User’s Manual. It may take some time to open up Excel over the internet so you should save these locally and open them on your computer.
- NJTA Concrete Median Barrier
- WSDOT Cable Median Barrier
- RDG Culvert Example

**User Submitted Examples**
If you have an example that you would like to share, please email it to the project team using the button at the top of the page. We will post it here.

**Requirements**
RSAPv3 is written as a series of Microsoft Excel macros. RSAPv3 will run on any Windows computer running Excel 14 or better and will run on both 32 and 64 bit computers. RSAPv3 has been successfully tested with Windows 7, Windows XP, and Vista.
Finding the RSAP Facebook Page

- Go to [http://www.facebook.com/RSAPv3](http://www.facebook.com/RSAPv3)
- Or ... search for the RSAPv3 Facebook Page by name within Facebook
- Or ... search for RSAPv3 in Google.
- Or ... If you see the RSAPv3 Page on a friend’s profile, you can click on the RSAP logo.
- When on the RSAPv3 Page, click on the "Like" button in the upper right hand corner.
RSAPv3
Software · Edit Info

RSAPv3
RSAPv3 Release 120116 has been posted on at http://rsap.roadsaferlc.com/
Unlike · Comment · Share · January 16 at 5:02pm

You like this.

1 share

Write a comment...

RSAPv3
After downloading and using the Alpha version of RSAPv3, please take this
survey to provide your feedback. Thank you!
Can you spare a few moments to take my survey?
www.surveymonkey.com
Please take the survey titled “RSAPv3 Software Evaluation”. Your feedback is
important!

Like · Comment · Share · January 15 at 11:30am
I’m not a Facebook user. Can I participate?

- The page is publicly **viewable**.
- Posting on the Page (i.e., full participation) does require joining Facebook.
- You can also go to the RSAPv3 download page (rsap.roadsafellc.com) and send a comment by email to **rsap@roadsafellc.com**.
- The development team will post responses on Facebook and also answer any emails.
Acknowledgments

The work is funded by the National Cooperative Highway Research Program (NCHRP) Project 22–27, “Roadside Safety Analysis Program (RSAP) Update.”
Thank you!

- Visit rsap.roadsafellc.com
  - Download the newest release of RSAPv3
  - Link to Facebook page.
  - Manuals which accompany the software.
  - List of improvements.
  - Register your copy.

- Questions? Email: rsap@roadsafellc.com