Program Timeline

Draft EIS

Supplemental Draft EIS

Viaduct begins to come down

2001	2002	2004	2006	2007	2012
Nisqually earthquake shook Puget Sound	Alternatives for environmental review selected			Begin Moving Forward Projects	

Public Input

Tell us how by:

Visit: www.wsdot.wa.gov/projects/viaduct

Email: viaduct@wsdot.wa.gov

Call: the program information line at 1-888-AWV-LINE

Write: Alaskan Way Viaduct and Seawall Replacement Program
c/o Washington State Department of Transportation
999 Third Ave, Suite 2424, Seattle, WA 98104

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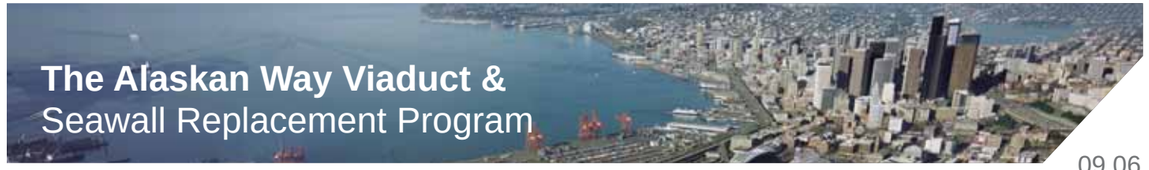

The Alaskan Way Viaduct & Seawall Replacement Program

09.06

A Retrofit is Not Enough

Several proposals have been made to retrofit the Alaskan Way Viaduct. WSDOT hired T.Y. Lin International to conduct an independent review of a proposal made by Victor Gray and the Viaduct Preservation Group, in order to see if the proposal would meet the earthquake standards used for Washington State bridges. After reviewing T.Y. Lin's work, WSDOT decided that a retrofit was not a wise investment of taxpayer dollars.

Streetscape rendering of the viaduct with the retrofit proposal.

What did the independent review find?

T.Y. Lin International found that the proposal to retrofit the viaduct makes some improvements, but doesn't go far enough to ensure the public is safe when an earthquake hits. When they evaluated what it would take to bring the proposal to current earthquake standards, the cost of a retrofit was $2.3 billion.

The retrofit is more than 80 percent of the cost of replacing the viaduct with a new elevated structure. WSDOT concluded that retrofitting the viaduct is not a responsible investment of taxpayer dollars.

What retrofit proposal was evaluated?

The Viaduct Preservation Group submitted a proposal in December 2004 to WSDOT that involved use of supplemental steel frames with shock absorbers, and soil improvement. In June 2006, the Viaduct Preservation Group submitted another proposal that was slightly different from the earlier version. The proposal included the following elements:

- Installation of steel strengthening frames running crosswise and lengthwise at the middle columns and bays of each viaduct section. The proposal did not include specific dimensions for these pieces of steel so T.Y. Lin International estimated the appropriate sizes.
- Wrapping of steel jackets around the base of some of the columns to provide additional strength to the structure. T.Y. Lin International believed these jackets would be required for all of the columns and so added them to the proposal.
- Placing of shock absorbers within the middle bay of the viaduct. Additional shock absorbers were shown between adjacent sections to prevent them from banging into each other during an earthquake. Because the evaluation looked at one section of the viaduct, these were not included. However, T.Y. Lin International concluded that these shock absorbers may serve to "lock" the sections together, synchronizing the movement of each section together

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Review of Retrofit Proposal

without dissipating any of the energy generated by the earthquake.

- Ground improvements were included, but soil improvements were not explicitly included in the evaluation. T.Y. Lin International observed that these improvements may adversely affect the movement of the foundations.

Rendering of retrofit proposal for area under the viaduct.

Standards for Evaluation

The retrofit proposal was evaluated for performance during three different magnitudes of earthquakes.

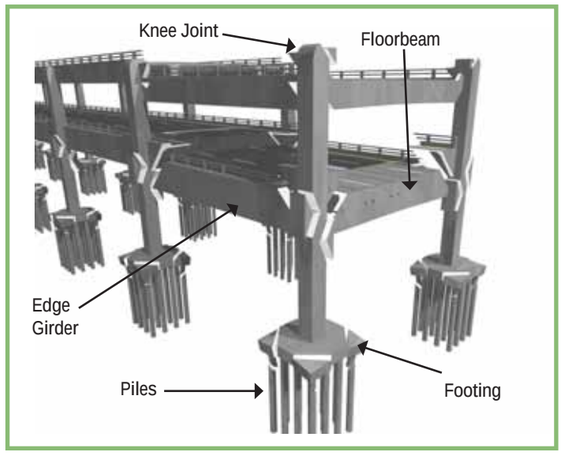
- The first earthquake is a **moderately bad earthquake** – one that has a greater than one in three chance of occurring in the next 50 years. The Nisqually earthquake in 2001 had a slightly greater intensity than this earthquake. Bridges should survive this earthquake without any significant damage.
- The second earthquake is a **bad earthquake** – one that is used as a benchmark to establish the minimum seismic standards for engineering design. Using this standard, bridges will not collapse in an earthquake of this magnitude and only minor repairs may be necessary before it is reopened to traffic. This earthquake has a one in ten chance of occurring in the next 50 years. By comparison, the Nisqually earthquake in 2001 was less intense than this level of earthquake.
- The third earthquake evaluated is a **very bad earthquake**. This earthquake has a two percent chance of occurring over the next 50 years. When bridges are built to these standards, it means that they will not collapse even though they may suffer serious damage that would require major repair or even full replacement. WSDOT is designing the elevated structure and tunnel alternatives to withstand this standard.

How did the retrofit proposal perform?

For the **moderately bad earthquake,** the evaluation conducted in August shows that even with a retrofit, there may be damage to the viaduct's foundation elements that will need repair.

For the **bad earthquake,** the evaluation shows that even with a retrofit, there is a high likelihood that the viaduct would be severely damaged and may collapse.

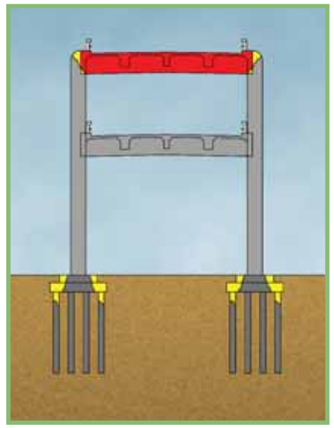
For the **very bad earthquake,** the evaluation shows that the retrofitted viaduct will collapse, likely causing loss of life.



The viaduct has many weak points that could cause it to collapse in a very bad earthquake.

The reasons for this collapse are:

- The **footings** of the viaduct would be subject to higher shear and flexural demands, and higher joint shears than for the bad earthquake. Severe damage of the footings is likely.
- The **piles** would be subject to higher compressive forces that cause severe damage to the footings.
- The **columns** will rock on the pilings, which they were not designed to do. This rocking may result in severe impacts to the adjacent viaduct sections. The columns are very brittle and the loads from the rocking plus the damage to the footings would likely cause the viaduct to collapse.
- Other parts of the viaduct will also be severely damaged and could fail. For example, the **floorbeams** will suffer from negative bending at the connection with the columns. **The knee joints** – some of which failed in the Nisqually earthquake – could also fail.



Shown in red is the expected damage for the design for 500-year earthquake.

Additional Improvements

In November, T.Y. Lin International identified the improvements needed for the Viaduct Preservation Group's retrofit proposal to meet the standard for the very bad earthquake. The additional improvements needed in order to meet an accepted standard of seismic risk are:

- The footings of the viaduct require a retrofit.
- The lower floor beam / column joints need to be strengthened.
- The joints between the columns and upper floor beams need to be replaced.

Cost Estimate

WSDOT priced the updated retrofit design, using the same cost estimation methods that are used when estimating the tunnel and elevated structure alternatives. This cost estimation includes design, inflation and risk.

The cost of fully retrofitting the viaduct is $2.3 billion. This full retrofit is more than 80 percent of the cost of replacing the viaduct with a new structure, so WSDOT has concluded that replacing the viaduct is the most responsible investment of taxpayer dollars. A retrofitted viaduct would only have a life span of about 25 years, and it would not provide the design upgrades such as wider lanes and shoulders that a replacement structure would.

Further Review

WSDOT asked the American Society of Civil Engineers (ASCE) to convene a panel of professional engineers to review T.Y. Lin's work.

The panel made several key observations about the Viaduct Preservation Group's original proposal:

- The proposal made by the Viaduct Preservation Group did not go far enough to address the structural issues and liquefiable soil. These are the key deficiencies leading to the viaduct's failure in the event of the minimum standard of seismic risks.
- The structural viability of the seawall cannot be considered as a separate issue from the viaduct's condition. The viaduct is dependent upon continued stability of the seawall and the Viaduct Preservation Group's proposal does not address this issue.
- The viaduct today suffers from no shoulders for broken down vehicles to pull out of traffic, narrow lanes; and unsafe rails and decking. The retrofit proposal does not allow for improving driver safety on the viaduct.
- The length of traffic disruptions during construction of a retrofit has been underestimated. There will likely be significantly longer disruptions than suggested by the Viaduct Preservation Group.

In addition, the ASCE panel made several observations about the retrofit plan developed by T.Y. Lin, pointing out that the costs of a retrofit would be higher than the limited benefits gained. The small difference in cost between a retrofit and a new structure would narrow because the maintenance costs for a retrofitted viaduct will be significantly more than a new structure built to present-day design standards.

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