FIELD AND LABORATORY INVESTIGATION OF BRIDGE ABUTMENT

BY

Robert F. Carlson
Gary Scarbrough
Jeffery Harping
Department of Civil Engineering
University of Alaska Fairbanks
Fairbanks, Alaska 99775

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16. Abstract

Efficient highway bridge design requires a good understanding of channel bottom scour around the pier and the abutment foundations. While research on bridge pier hydraulics has resulted in reliable equations for estimating the depth of pier scour, bridge abutment scour depth equations have so far proved to be not completely reliable when applied to field problems. We were able to develop a method depends on simple fluid principles of uniform horizontal that shear distribution, numerical solution of Laplace equation for 2-dimensional flow around bridge abutments, adjustment of empirical parameters by comparison to laboratory measurements, and the assumption a fully mobile bed sediment movement. The theoretical development results in a prediction of dimensionless scour depth as a simple function of the stream tube contraction at the upstream corner of the abutment. The prediction equation, when compared to laboratory experimental results and a standard regression equation, showed consistent results. When a direct comparison can be made, the prediction equation seemed to give more reasonable results and predicted less scour than that of the standard regression equation. Case studies of two highway bridge crossings near Fairbanks, Alaska showed that the prediction technique has promise as a practical method for evaluating channel scour at bridge abutments.

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ABSTRACT

Efficient highway bridge design requires a good understanding of channel bottom scour around the pier and abutment foundations. While research on bridge pier hydraulics has resulted in reliable equations for estimating the depth of pier scour, bridge abutment scour depth equations have so far proved to be not completely reliable when applied to field problems. We were able to develop a method depends on simple fluid principles of uniform horizontal that shear distribution, numerical solution of the Laplace equation for 2-dimensional flow around bridge abutments, adjustment of empirical parameters by comparison to laboratory measurements, and the assumption a fully mobile bed sediment movement. The theoretical development results in a prediction of dimensionless scour depth as a simple function of the stream tube contraction at the upstream corner of the abutment. The prediction equation, when compared to laboratory experimental results and a standard regression equation, showed consistent results. When a direct comparison can be made, the prediction equation seemed to give more reasonable results and predicted less scour than that of the standard regression equation. Case studies of two highway bridge crossings near Fairbanks, Alaska showed that the prediction technique has promise as a practical method for evaluating channel scour at bridge abutments.

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1. INTRODUCTION

This project, "Field and Laboratory Investigation of Bridge Abutment Scour," was designed to be conducted with two funding phases. This final report describes the activities accomplished with the available funds. The Phase II portion of the work can be completed when funds become available. In the Phase I activity, researchers conducted a literature search of methods for determining bridge abutment scour that could be adapted to Alaska streams, developed a conceptual framework for calculating bridge abutment scour, evaluated equation parameters in the laboratory and conducted limited field evaluations at two bridges.

The original project objectives were:

1) Survey present methods of bridge abutment scour in Alaska and in the Western region states. Assess what methods seem effective and what portions need improvement. Carefully delineate the abutment scour computation needs of AKDOT&PF hydraulic designers including characterization of stream channels, type and size of abutments, flood flow estimation and ease and reliability of present methods.

2) Develop a research strategy that will lead to a useful computation of bridge scour in Alaska. Coordinate with other stream data programs such as the U.S. Geological Survey (USGS) stream measurement program.

3) Use a combination of laboratory and field experiments to investigate the depth of

abutment scour and adjust current empirical equations. Make extensive use of the newly developed UAF-CE bottom scour sensor.

4) Work closely with AKDOT&PF hydraulic engineers to develop a final estimation method that will allow for better design of bridge structures and present the results in a useful manner.

With the resources available for this first phase, researchers completed the first two objectives and part of the third. The remaining work must wait on funding of a Phase II project.

The project proposal called for three reports:

1) Summary report on existing methods (Submitted 8/3/93).

2) Summary report on research strategy (Submitted 8/3/93).

3) Final Draft Report.

The first two are included as appendices in this final report. This report completes the project.

2. BACKGROUND

The purpose of this project was to determine whether improved equations could be developed for predicting scour depths around bridge abutments. A working theoretical expression was developed by making several assumptions (discussed in section 3) and then applying Bernoulli's equation. With the developed theoretical expression, the results from the

computer and laboratory experiments were used to evaluate the equation parameters. Some limited field tests were conducted. If a second phase of the work should be conducted, the equation prediction values could be tested with further field tests throughout the state.

3. THEORETICAL DEVELOPMENT

The development of a theoretical equation for determining the extent of flood scouring around a bridge abutment began with the following assumptions:

1) Most of the channel shear resistance with the flow is equally laterally distributed along the bottom of the channel. The channel sides have relatively little effect on the flow distribution and the flow is assumed to be of constant depth.

2) As a consequence of item 1, the ideal flow principles of fluid mechanics can be used and the Laplace equation can be applied for numerical computation.

3) The Froude number for open channel flow can be used for scaling the results of laboratory and computation results to a full size abutment configuration.

4) The abutment scour problem is determined primarily by the flow between the channel side and a streamline boundary adjacent to the bank.

Using the previous assumptions, the abutment scour can be computed through the following steps:

1) Establish the upstream flow conditions as uniform during the design flow under consideration. This condition is illustrated in Figures 1 and 2.

2) Select the number of stream tubes to be used for the analysis, usually a convenient number such as ten. The upstream flow is then considered to be equally distributed and given by Q_i for each of the m stream tubes. Q_T represents the total flow of the stream. The width of the side stream tube of interest is calculated as b_o, where B is the total width of the stream.

$$Q_i = Q_T/m \; ; \quad b_o = B/m.$$

3) At this point, the streamline location must be determined. An abutment configuration is established and the flow distribution is assumed to be given by the ideal fluid flow distribution. Laplace's equation for ideal fluid flow can be used as a first approximation. Later, a more complete finite element-based determination could be made.

4) Now consider the side stream tube illustrated below in Figure 3. The points of interest are the upstream width, b_o and the width at a point of interest, b_a. In the present case, the point of interest is the upstream corner of the bridge abutment.

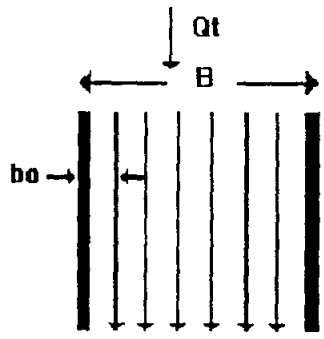


Figure 1: Streamlines Through a Channel.

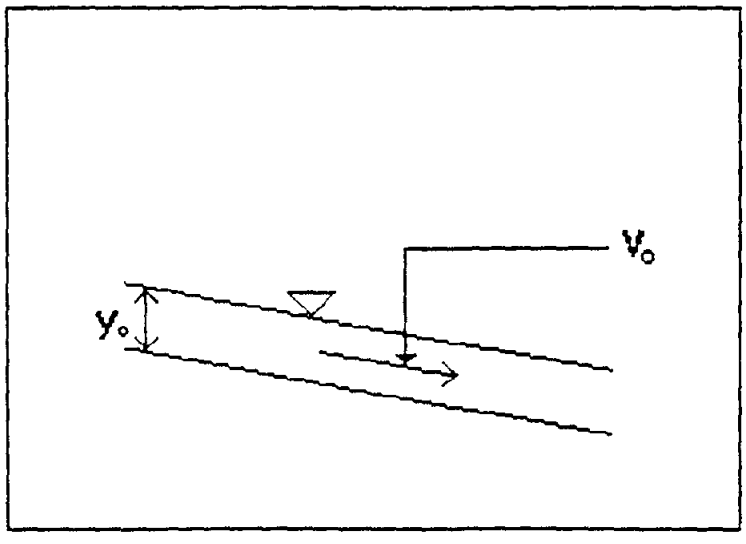


Figure 2: Depth (y_0) and Velocity (v_0): A Representation of Channel Flow

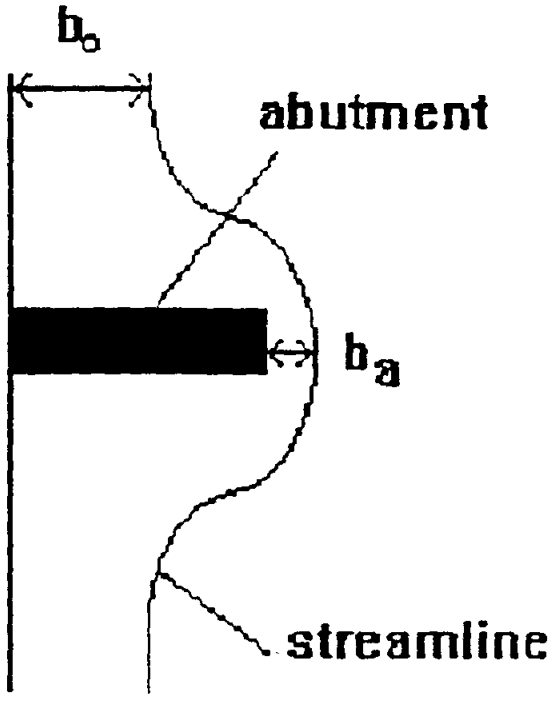


Figure 3: Distance of Streamline from Bank or Abutment

5) The specific discharge, q, is defined as,

$$q = Q_I / b_o ,$$

and the velocity is given as

$$V = q / y_o ,$$

where y is the normal depth.

6) A key assumption is that the bed sediment is in a live phase. The live bed phenomenon is often considered to be a condition of maximum scour. Maximum scour occurs when the rate of material removal equals that of replenishment, thus resulting in an equilibrium depth (see Figure 4). At the equilibrium condition, the flow velocity is considered to be at the critical scour velocity as dictated by the bed material grain size. This yields the assumption that the upstream velocity is approximately equal to the scour hole velocity:

$$V = V_o = V_{cr}$$

7)The Bernoulli equation can be written along a streamline between an upstream point and the upstream corner of the abutment,

$$y + V^2/2g + Z = y_o + V_o^2/2g + Z_o.$$

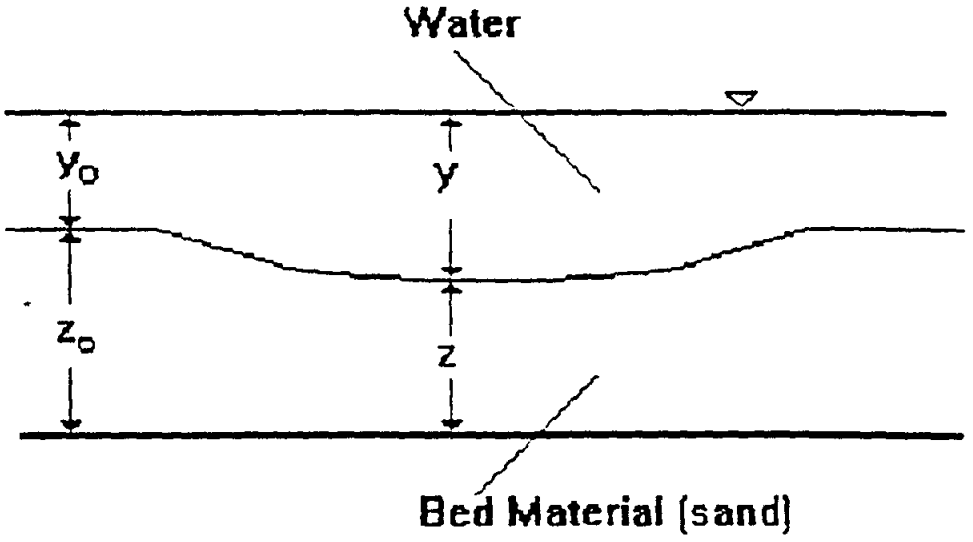


Figure 4: Longitudinal View of Channel and Scour Hole

8) The final scour depth equation is developed in the following steps:

$$\text{Max scour at } V = V_o, \text{ and } y + Z = y_o + Z_0,$$

$$(Z_o - Z)/y_o = y/y_o - 1$$

$$Q_I = V_o b_o y_o = V b_a y,$$

$$b_o/b_a = y/y_0 \text{ OR}$$

$$(Z_o - Z)/y_o = b_o/b_a - 1. \qquad \text{Eq. 1}$$

Equation 1 gives a prediction of dimensionless scour depth as a simple function of the stream tube flow contraction at the upstream corner of the abutment. The next step is to determine the width of the stream tube. As previously mentioned, this step can be accomplished with a solution of Laplace's Equation at ideal fluid flow conditions. Ideal fluid flow, in turn, is approximated by the assumption of equally distributed bottom shear stress. The scour prediction equation requires a determination of the stream tube width at the upstream corner of the abutment. In order to determine the stream tube width, a calculation of the flow or streamline distribution for the pertinent abutment configuration was required. The streamline distribution was determined by solving the Laplace Equation for the stream function using a computer generated model.

4. COMPUTATION PROCEDURE

Six abutment conditions were modeled using an iterative solution of Laplace's equation. The equation was simplified using two assumptions:

1) The channel boundary shear resistance is equally distributed laterally along the bottom of the channel.

2) The channel sides have relatively little effect on the flow distribution.

Since the finite difference method requires an iterative process, a spreadsheet program was utilized to tabulate the results. The general procedure used to create the computer models is described in the following method:

1) For each trial, the right edge of the solution (represented on the left side of the diagram, Figure 5 was specified to be a streamline value of 1.0. The streamline valued at 2.0 was used as the left side of the stream tube for the analysis. (The streamline values have no significance in themselves, but they serve as labels for the streamlines, and they allow the location of the streamlines to be calculated.) The boundaries across the stream channel, both upstream and downstream of the abutment, are specified to give a uniform flow condition. The numerical computation proceeds as follows:

2) The boundary values are set as described above, 1.0 for the right bank and an arbitrary value for the middle of the channel.

3) Each of the interior points are calculated to be the average of the surrounding points. This computation is discussed in most fluid mechanics books, and it satisfies the condition that Laplace's equation explain the position of the streamlines for equal bottom shear and

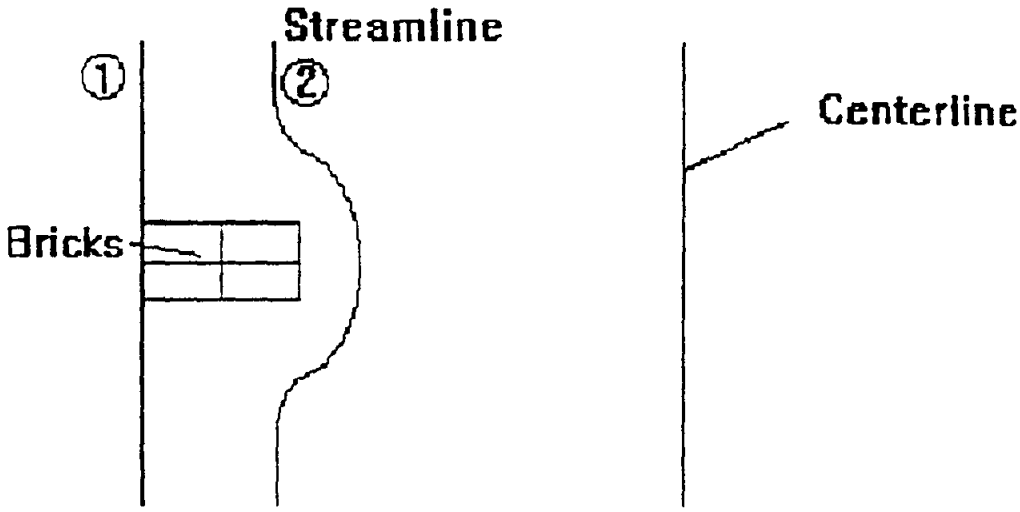


Figure 5: Distance of Streamlines from Bank or Abutment

the principle of continuity. Special equations are specified for the boundaries.

4) The computation is repeated through the automatic iteration mode in the spreadsheet program. When the values no longer change, the solution is achieved and the distribution of the streamline values represents that of the channel flow.

Six abutment conditions were modeled and are shown in Appendix D:

1) Vertical wall with a 45° stagnation point.

2) Spill through with a 45° stagnation point.

3) Guidebank with a 45° stagnation point.

4) A vertical wall without a stagnation point.

5) A spill through abutment without a stagnation point.

6) A guidebank without a stagnation point.

The results of the flow distribution determination are shown in Appendix D. Note that several figures are shown in two parts. The two points of interest for each encroachment configuration are the upstream width between streamlines 1 and 2 and the corresponding horizontal width between 1 and 2 at the upstream corner of the abutment. These are the respective widths b_o and b_a used in the scour prediction equation.

The Laplace equation solution results in a grid of numbers. From this grid, streamline 2 was chosen as the point of reference. Interpolation between the numbers was used to determine the precise location of this streamline. For interpolation purposes, the exact location of any number was chosen as its decimal point.

Two solution scales were prepared for each configuration:

1) A global view, which presented the abutment and the surrounding region.

2) An expanded view, which focused on the region immediately surrounding the tip of the abutment.

The global view provides an overall solution to the model from which constant boundary conditions were obtained from points of known values. Interpolation between these points is used to generate the necessary boundary conditions for the expanded view. The size of the grid was a function of accuracy requirements, computational time considerations and approximation of uniform flow conditions. A trade-off occurred between the accuracy of the solution and the time required to solve the equation. As the accuracy increased, the time required for the computer to solve the equation increased proportionally.

The expanded view illustrates the area encompassing the tip of the abutment. This view was produced by expanding the lengths of the global view by a scaling factor. The scaling factor varied by abutment type and ranged from 4 to 5. The initial conditions were obtained from the final global solution. In order to locate global data points, a similar coordinate system was used in the expanded view. This coordinate system was enlarged in both the horizontal and vertical directions by the scaling factor.

In both the global and expanded view, symmetry was used to help determine the reliability of results. A properly designed model should be symmetrical about a horizontal axis intersecting the bridge abutment. The three primary causes for an asymmetrical solution were:

1) Error in the finite difference formula.

2) Non-convergence of the solution.

3) An asymmetrical abutment.

The symmetry and accuracy of the solution is dependent upon the number of iterations. Too few iterations will result in a solution that has not converged and thus was slightly asymmetrical. The use of an abutment that was not symmetrical about the horizontal axis will create a correct solution that is asymmetrical.

5. LABORATORY PARAMETER EVALUATION

The laboratory experiments for the work were performed in a 2x2 foot open channel test flume at the UAF Department of Civil Engineering's Hydraulics Laboratory. Three types of abutments were tested during the laboratory experiments: vertical wall, spill through, and guidebank. Although the same computation scheme applied to each abutment type, the construction procedure changed due to their different shapes. In all of the experiments, the material for the bed and bridge abutment was sand and bricks, respectively (see Figure 6). For the spill though and guidebank abutments, small gravel riprap was utilized to create the necessary shape (see Figure 7).

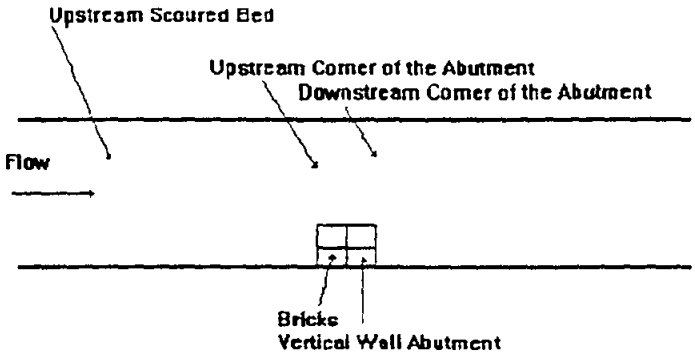


Figure 6: Plan View of Vertical Wall Abutment

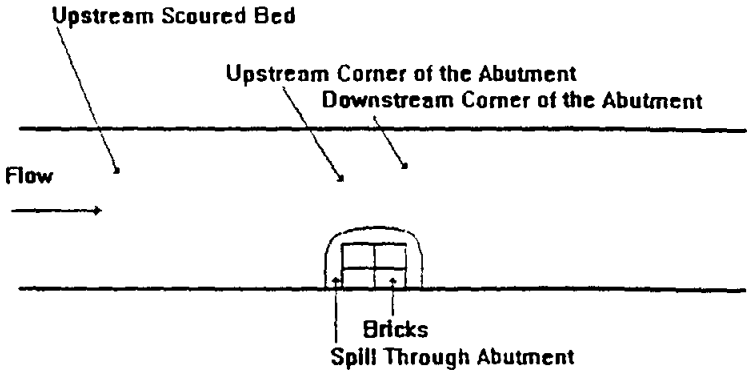


Figure 7: Plan View of Spill Through Abutment

A general procedure is outlined below with necessary changes to compensate for varying abutment types:

1) The bed material was excavated in order to bury the bridge abutment and protect the toe of the riprap.

2) The appropriate number of bricks were placed along the edge of the flume to produce the proper encroachment ratio.

3) Riprap was placed around the bricks, at an approximate 40 degree angle, to simulate the spill through and guidebank shapes.

4) The bed material in the flume was replaced and leveled so the toe of the riprap and the bricks were protected from the impending scour.

5) The water height was raised to aid in compacting the bed material around the abutment and exposed riprap.

6) The bed material was leveled.

7) Additional bricks were placed at the end of the flume to control the flow of the water.

8) A cross section of the original bed surface was recorded.

9) The flume's manometers were checked for equilibrium.

10) The pump was started, allowing the flow of water.

11) The flow was increased until a live bed condition was achieved.

12) An upstream height from the bed to the water surface was recorded.

13) The velocity head was measured using a Pitot tube.

14) The height of the water in the manometers were recorded.

15) The flow was halted.

16) A dam was created at the end of the flume to allow slow drainage of the water, preventing destruction of the bed profile.

17) Three cross sections were measured for the vertical wall and spill through abutments, whereas four profiles were measured for the guidebank abutment (see Figure 8).

The encroachment ratio, described in Step 2, is defined as B'/B. The denominator B of the expression is the width of the flume and was constant for all abutment types. The numerator (B') of the expression was measured from the side of the flume, along the central horizontal axis of the bricks, to the point of contact the abutment made with the sand (see Figure 9). This point of contact for the vertical wall abutment was the intersection of the sand and the tip of the brick. For the spill through and guidebank abutments, the point of contact coincided with the end of the above ground portion of the riprap and the sand.

The riprap, described in Step 3, was fine gravel (classified as GP according to the Unified Soils Classification System), passing the 3/8" sieve and retained on the No. 4 sieve. The slope of the riprap corresponded to the angle of repose for the gravel.

In Step 5, the bed material was compacted around the abutment until it was the same consistency as the rest of the bed. This was a necessary step because the scour depth is effected by the consistency of the bed material.

Step 11 required that the flow be increased until a live bed condition existed. At live bed conditions, the maximum scour will occur when equilibrium is reached between the deposit and removal of sediments in the scour hole.

The upstream height of the flowing water was measured in Step 12. This measurement was taken in the center of the flow, upstream from the abutment. This location was also used for

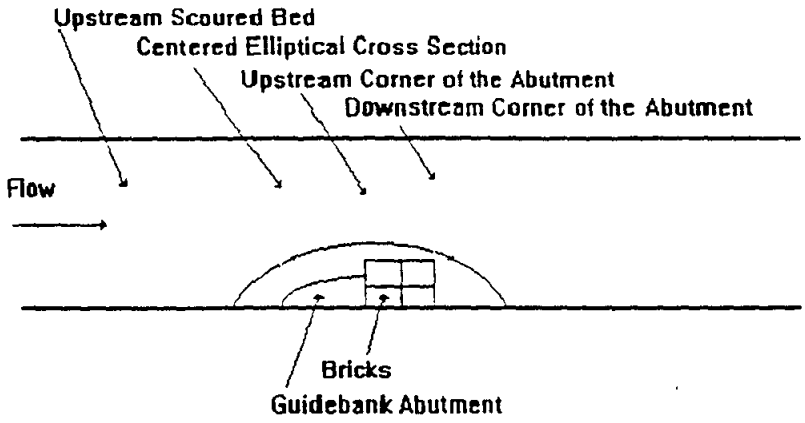


Figure 8: Plan View of Guidebank Abutment

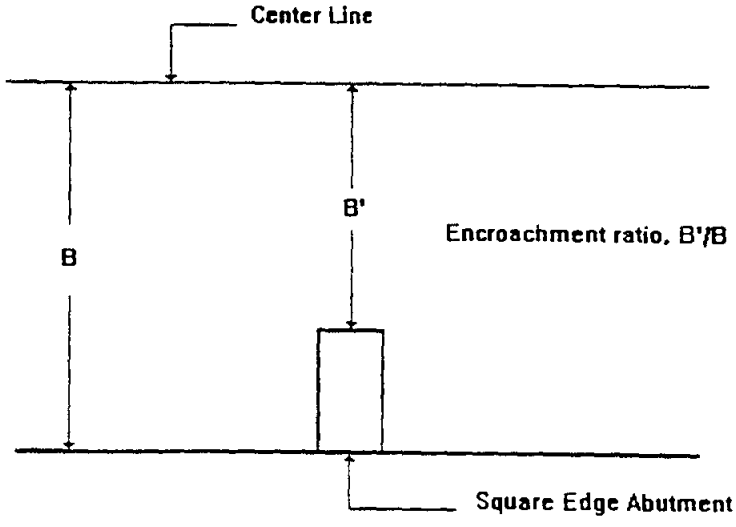


Figure 9: Encroachment Ratio for Vertical Wall Abutment

measuring the velocity head. Measurement of the velocity head, for Step 13, was accomplished through the use of a Pitot tube.

The distance to the upstream cross section, referenced in both Steps 8 and 17, changed for each abutment. The distances to the cross section, from the upstream corner of the abutment, are displayed the chart below.

Type of abutment	Distance from upstream corner of abutment
Vertical Wall	.366 meters
Spill Through	.366 meters
Guide Abutment	.50 meters

Some cross sectional measurements were affected by riprap dislodging from the abutment. This displaced riprap created local scour pockets, in addition to the overall scour. During cross section measurements, these points were averaged with the surrounding unaffected area in order to obtain an approximate reading.

6. RESULTS AND DISCUSSION

6.1 Vertical Wall Abutment

The raw data and tabulated results for the computer model and laboratory experiments are found in Appendix A, Tables 1 and 2 respectively. The computer model for the vertical wall abutment described a near linear relationship between the dimensionless expressions of B'/B and

$(Z_o-Z)/y_o$. The laboratory experiments indicated results in the form of a power curve ($y=c*x^d$). One probable reason for this difference was that the basic assumptions of the scour prediction equation and the corresponding flow distribution computation were violated in real flow situations. Probably the most unrealistic assumptions were the exclusion of the free shear boundary, which often forms upstream of the abutment, and the assumption of equal velocities in the side stream tube as the bottom scour develops.

In order to account for the differences, a procedure was utilized to fit the computer model to the laboratory experiments. This procedure used the least squared method to determine the values of two coefficients, c and d, that would best fit the computer model to the laboratory results. The steps used to calculate these coefficients are listed below:

1) The computer model results were tabulated and placed in the first column.

2) Initial values of one for the coefficients were placed in the second and third columns, respectively.

3) The computer model was recalculated in Column four by the following equation:

Column 4 = Column 2 * (Column 1 ^ Column 3)

y = c * (x ^ d)

4) The results from the laboratory experiments were placed in the fifth column.

5) In the sixth column, the difference of Column 5 and Column 6 was squared. At the bottom of Column 6, these differences were added to create a sum.

6) Subsequent assumptions were tried and the resulting value at the bottom of Column 6

was compared to the previous sum.

7) If the new result of the coefficients created a smaller sum, then those values were used as the new comparison value.

8) This iterative method continued until the sum of the squares could no longer be reduced to the available accuracy.

9) At this point, the subsequent c and d values were used to fit the computer model to the laboratory results.

Through this process, values for the coefficients were determined to the hundredth decimal place for the vertical wall abutment. Table 1 in Appendix B shows the calculations and the values for the c and d coefficients. The coefficients c and d were 1.45 and .54, respectively.

The results from two equations, which are used to predict the scour around a vertical wall abutment, were overlaid to provide a comparison with the laboratory data (Appendix C, Graph 1). These equations, found in Highways in the River Environment (1990), were developed by Liu, et al., (1961) and by Laursen (1980). Lui's equation predicts the depth of local scour, whereas Laursen's equation predicts the sum of both local and contraction scour. According to our laboratory results, both equations over predicted the depth of scour.

6.2 Spill Through Abutment Results

The raw data and tabulated results for the computer model and laboratory experiments are found in Appendix A, Tables 3 and 4 respectively. The computer model for the spill through abutment described an approximate linear relationship between the dimensionless expressions of

B'/B and $(Z_o-Z)/y_o$, whereas the results from the laboratory experiments were in the form of a power curve ($y=c*x^d$). A probable reason for this difference was that the basic assumptions of the scour prediction equation and the corresponding flow distribution computation were violated in real flow situations. Probably the most unrealistic assumptions were the exclusion of the free shear boundary, which often forms upstream of the abutment, and the assumption of equal velocities in the side stream tube as the bottom scour develops.

A best fit curve, using the same procedure listed in the vertical wall abutment results, was utilized to fit the computer model to the laboratory findings. The calculations and results of this curve are shown in Appendix B, Table 2. The c and d coefficients were .67 and .27 respectively.

As stated earlier, Liu et. al (1961) developed an equation that predicts the scour depth around a spill through abutment. For this project, this equation was overlaid and shown in Appendix C, Graph 2. In this equation, Lui did not address the effects of contraction scour. When compared to the results from our studies, this equation over-predicted the depth of scour.

6.3 Guidebank Abutment Results

The raw data and tabulated results for the computer model and laboratory experiments are found in Appendix A, Tables 5 and 6 respectively. The computer model for the guidebank abutment described a linear relationship between the dimensionless expressions of B'/B and $(Z_o-Z)/y_o$, whereas the results from the laboratory experiments were in the form of a power curve ($y=c*x^d$). Again, a probable reason for this difference is that the basic assumptions of the scour prediction equation and the corresponding flow distribution computation were violated in real flow situations. Probably the most unrealistic assumptions were the exclusion of the free shear

boundary, which often forms upstream of the abutment, and the assumption of equal velocities in the side stream tube as the bottom scour develops.

A best fit curve, as previously described, was utilized to fit the computer model to the laboratory results. The calculations and results are shown in Appendix B, Table 3. The resulting c and d values were .37 and .73 respectively. The results from the computer model, laboratory experiments and the best fit curve were graphed and the resulting graph is located in Appendix C, Graph 3.

The values of the c and d coefficients are shown below for each abutment type.

Abutment Type	c Coefficient	d Coefficient
Vertical Wall Abutment	1.45	.54
Spill Through Abutment	.69	.27
Guidebank Abutment	.37	.73

The results for the laboratory experiments were graphed for each abutment type. This graph is located in Appendix C, Graph 4. The depth of scour for the spill through and guidebank abutments were approximately equal. The small difference may be attributed to laboratory error. A large depth of scour was measured for the vertical wall abutment.

7. CONCLUSION

Estimation of stream bottom scour at bridge abutments is a difficult endeavor. Abutments are designed in many different shapes and configurations. Attempts to develop regression type equations based on a few laboratory configurations have been difficult to use and usually tend to give overly conservative results.

We have developed a calculation method that used a few simple fluid mechanics principles, numerical calculation for a particular abutment configuration and parameter estimation with laboratory testing. The results indicated in this report suggest that we may be headed in a useful direction. The prime estimation equation is simple to use and is based on a sound concept, a completely active bed at flood scouring velocities. The application of the Laplace equation to shear free flow in the horizontal plane is somewhat more tenuous in that the vertical shear boundaries along the upstream separation zones cannot be easily accounted for. The use of a experimental laboratory test to evaluate the equation parameters appears very promising. For a bridge costing several million dollars, the cost of a laboratory test would be but a small percentage of the total cost.

Overall, we feel the combined approach of fluid principle application, numerical computation and laboratory testing is a solid advance for the estimation of bridge abutment scour. We encourage further development work in this area with emphasis on further tests of actual field installations.

APPENDIX A

LABORATORY DATA AND CALCULATED RESULTS OF VARIOUS CONFIGURATIONS

Table 1 (Raw Data and Calculated Results for the Vertical Wall Abutment Computer Model)

Encroachment Ratio B'/B	Measurement of b_o to Streamline 2 (mm)	Scaled Measurement of b_a to Streamline 2 (mm)	b_a Scaling Factor	Actual Measurement of b_a to Streamline 2 (mm)	Determination of (Zo-Z)/yo = (b_o/b_a-1)
1.00					0.00
0.906	11.0	34	5	6.8	0.62
0.813	11.0	21	5	4.2	1.62
0.75	11.0	18	5	3.6	2.06
0.625	11.0	13	5	2.6	3.23

Table 2 (Raw Data and Calculated Results for the Vertical Wall Abutment Laboratory Experiments)

Raw Data from Vertical Wall Abutment (Brick Abutment and Sand Base)

Brick across	Brick out	Datum to Water (cm)	Datum to Scour (cm)	Datum to Original Surface (cm)	Velocity Head (cm)	Manometer Left Leg (in)	Manometer Right Leg (in)
2	1	39.7	49	44	1.5	4.8	8.6
2	2	39.5	53	44.4	1.4	4.7	8.7
2	3	39.5	53	43.6	1.3	6.3	7.1
2	4	39.8	53.8	43.6	1.35	5.4	8.2

Calculations for Vertical Wall Abutment (Brick Abutment and Sand Base)

Zo-Z (cm)	Average y_o (cm)	Velocity (m/s)	Froude Number	Abutment Length (cm)	Encroachment Ratio B'/B	Laboratory Results $(Z_o-Z)/y_{o\ lab}$	Results of Best Fit Equation	Results to Computer Model	Results From Liu Eq 5.17	Results From Liu Eq 5.19
					1.00	0.00	0.00	0.00	0.00	0.00
5	4.3	0.54	0.84	5.75	0.91	1.16	1.12	0.62	2.28	1.73
8.6	4.9	0.52	0.76	11.50	0.81	1.76	1.88	1.62	2.73	2.27
9.4	4.1	0.51	0.80	17.25	0.72	2.29	2.14	2.06	3.56	3.00
10.2	3.8	0.51	0.84	23.00	0.62	2.68	2.73	3.23	4.19	3.57

Table 3 (Raw Data and Calculated Results for the Spill Through Abutment Computer Model)

Encroachment Ratio B'/B	Measurement of b_o to Streamline 2 (mm)	Scaled Measurement of b_a to Streamline 2 (mm)	b_a Scaling Factor	Actual Measurement of b_a to Streamline 2 (mm)	Determination of (Zo-Z)/yo = (b_o/b_a-1)
1.00					0.00
0.906	11.0	34	5	6.8	0.62
0.813	11.0	22	5	4.4	1.50
0.75	11.0	18	5	3.6	2.06
0.625	11.0	14	5	2.8	2.93

Table 4 (Raw Data and Calculated Results for the Spill Through Abutment Laboratory Experiments

Raw Data from Spill Through Abutment (Gravel Abutment and Sand Base)

Brick across	Brick out	Datum to Water (cm)	Datum to Scour (cm)	Datum to Original Surface (cm)	Velocity Head (cm)	Manometer Left Leg (in)	Manometer Right Leg (in)
2	1	39.4	46.5	43.76	1.4	7.5	11.9
2	2	39	47.2	43.8	1.4	7.5	11.7
2	3	39	47.9	43.72	1.2	7.8	11.5
2	4	38.6	48	43.5	1.3	7.3	12

Calculations for Spill Through Abutment (Gravel Abutment and Sand Base)

Zo-Z (cm)	Average y_o (cm)	Velocity (m/s)	Froude Number	Abutment Length (cm)	Encroachment Ratio B'/B	Laboratory Results $(Z_o-Z)/y_{o\,lab}$	Results From Liu Eqn 5.16	Results of Best Fit Equation	Results to Computer Model
					1.000	0.000	0.000	0.000	
2.740	4.360	0.524	0.801	18.750	0.692	0.628	1.833	0.606	
3.400	4.800	0.524	0.764	26.000	0.573	0.708	1.978	0.770	
4.180	4.720	0.485	0.713	30.250	0.504	0.886	2.068	0.838	
4.500	4.900	0.505	0.728	36.000	0.409	0.918	2.200	0.922	
					1.000				0.000
				5.750	0.906				0.618
				11.500	0.811				1.500
				17.250	0.717				2.056
				23.000	0.623				2.929

Table 5 (Raw Data and Calculated Results for the Guidebank Abutment Computer Model)

Encroachment Ratio B'/B	Measurement of b_o to Streamline 2 (mm)	Scaled Measurement of b_a to Streamline 2 (mm)	b_a Scaling Factor	Actual Measurement of b_a to Streamline 2 (mm)	Determination of (Zo-Z)/yo = (b_o/b_a-1)
1.00					0.00
0.906	11.0	27	4	6.75	0.63
0.813	11.0	20	4	5	1.20
0.75	11.0	17	4	4.25	1.59
0.625	11.0	15	4	3.75	1.93

Table 6 (Raw Data and Calculated Results for the Guidebank Abutment Laboratory Experiments)

Raw Data from Guide Abutment (Gravel Abutment and Sand Base)

Brick across	Brick out	Datum to Water (cm)	Datum to Scour (cm)	Datum to Original Surface (cm)	Velocity Head (cm)	Manometer Left Leg (in)	Manometer Right Leg (in)
2	0	39.2	46.2	44.62	1.3	7.4	12.3
2	1	39.2	46.4	44.44	1.4	7.7	12.4
2	2	39.2	46.5	44.16	1.25	7.6	12
2	3	38.9	47.4	44.06	1.3	7.4	12.1

Calculations for Guide Abutment (Gravel Abutment and Sand Base)

Zo-Z (cm)	Average y_o (cm)	Velocity (m/s)	Froude Number	Abutment Length (cm)	Encroachment Ratio B'/B	Laboratory Results $(Z_o-Z)/y_{o\,lab}$	Results of Best Fit Equation	Results to Computer Model
					1.000	0.000	0.000	
1.580	5.420	0.505	0.693	13.000	0.787	0.292	0.264	
1.960	5.240	0.524	0.731	15.750	0.742	0.374	0.423	
2.340	4.960	0.495	0.710	23.500	0.615	0.472	0.519	
3.340	5.160	0.505	0.710	30.250	0.504	0.647	0.599	
					1.000			0.000
				5.750	0.906			0.630
				11.500	0.811			1.200
				17.250	0.717			1.588
				23.000	0.623			1.933

APPENDIX B

CALCULATIONS OF BEST FIT CURVE TO LABORATORY RESULTS

Table 1 (Best Fit Calculations and Results for Vertical Wall Abutment)

Computer Model Results	c coeffecient	d coeffecient	Best Fit of Computer Model y=cx^d	Laboratory Results (Zo-Z)/yo	Difference of Squares
0.000	1.450	0.540	0.000	0.000	0.000
0.618	1.450	0.540	1.118	1.163	0.002
1.619	1.450	0.540	1.881	1.755	0.016
2.055	1.450	0.540	2.139	2.293	0.024
3.231	1.450	0.540	2.731	2.684	0.002
				Sum	0.044

Table 2 (Best Fit Calculations and Results for Spill Through Abutment)

Computer Model Results	c coeffecient	d coeffecient	Best Fit of Computer Model y=cx^d	Laboratory Results (Zo-Z)/yo	Difference of Squares
0.000	0.690	0.270	0.000	0.000	0.000
0.618	0.690	0.270	0.606	0.628	0.001
1.500	0.690	0.270	0.770	0.708	0.004
2.056	0.690	0.270	0.838	0.886	0.002
2.929	0.690	0.270	0.922	0.918	0.000
				Sum	0.007

Table 3 (Best Fit Calculations and Results for Guidebank Abutment)

Computer Model Results	c coeffecient	d coeffecient	Best Fit of Computer Model y=cx^d	Laboratory Results (Zo-Z)/yo	Difference of Squares
0.000	0.370	0.730	0.000	0.000	0.000
0.630	0.370	0.730	0.264	0.292	0.001
1.200	0.370	0.730	0.423	0.374	0.002
1.588	0.370	0.730	0.519	0.472	0.002
1.933	0.370	0.730	0.599	0.647	0.002
				Sum	0.008

APPENDIX C

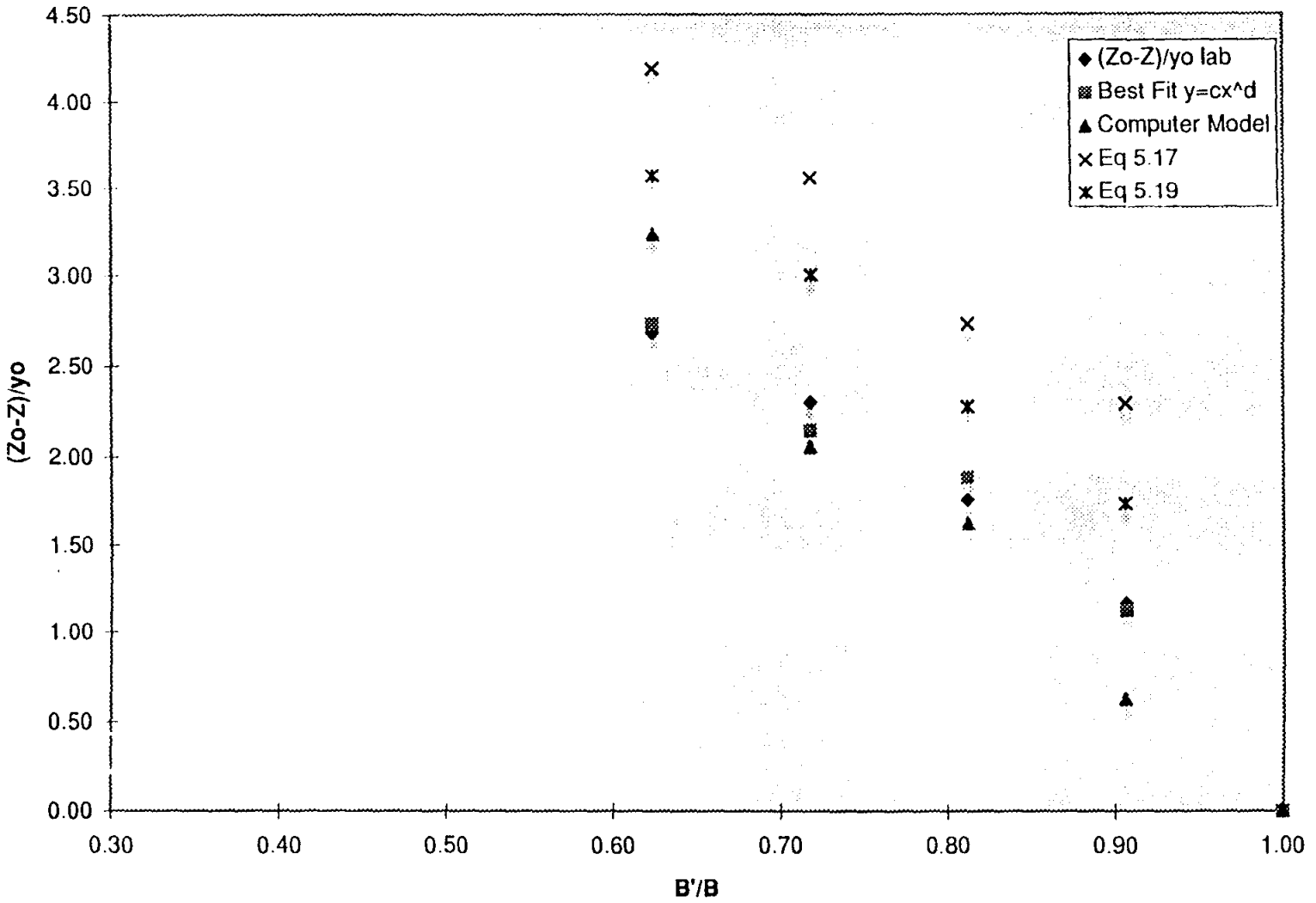
COMPARISON OF LABORATORY RESULTS,

BEST FIT EQUATION,

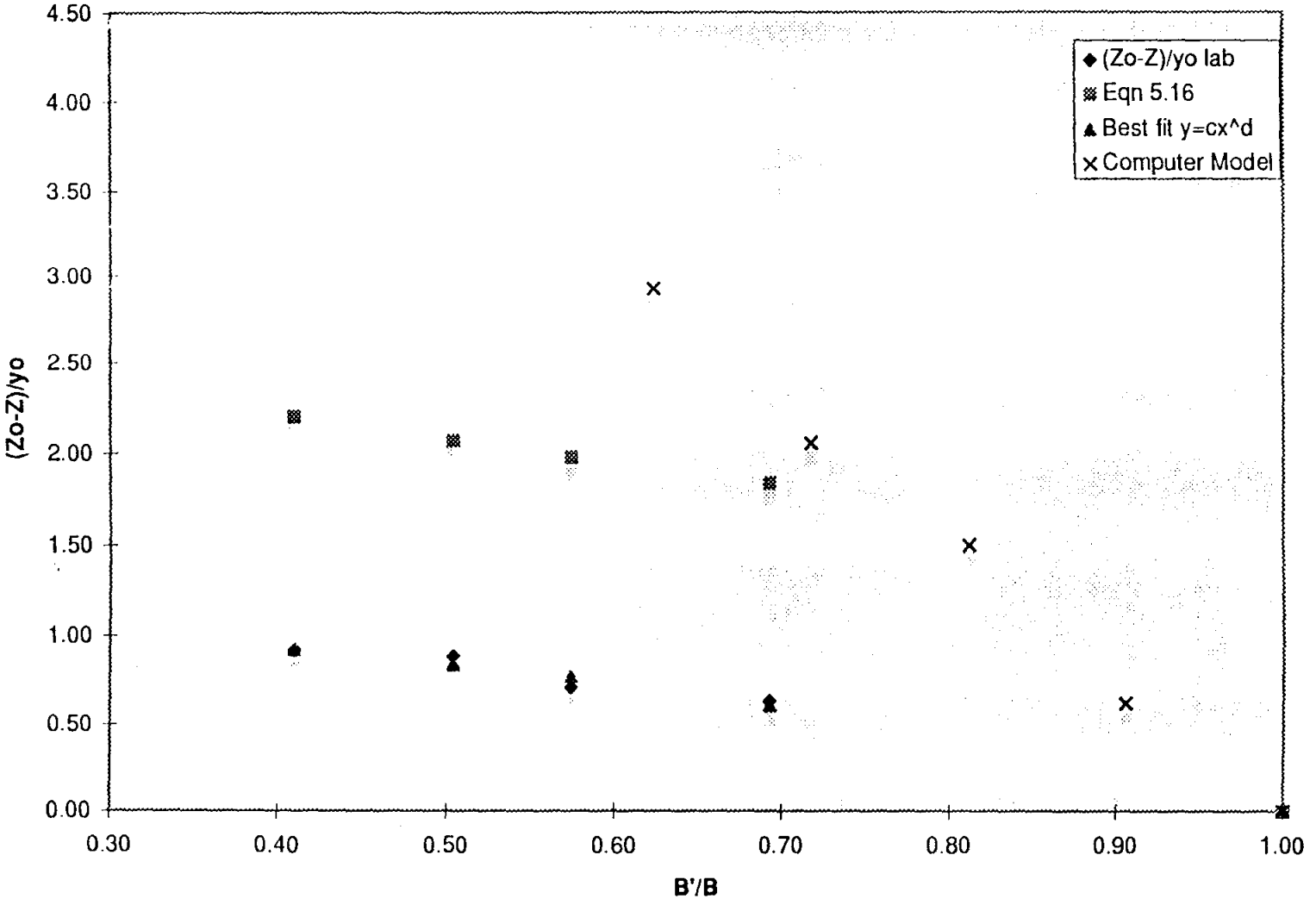
PREDICTION EQUATION AND

STANDARD EQUATION

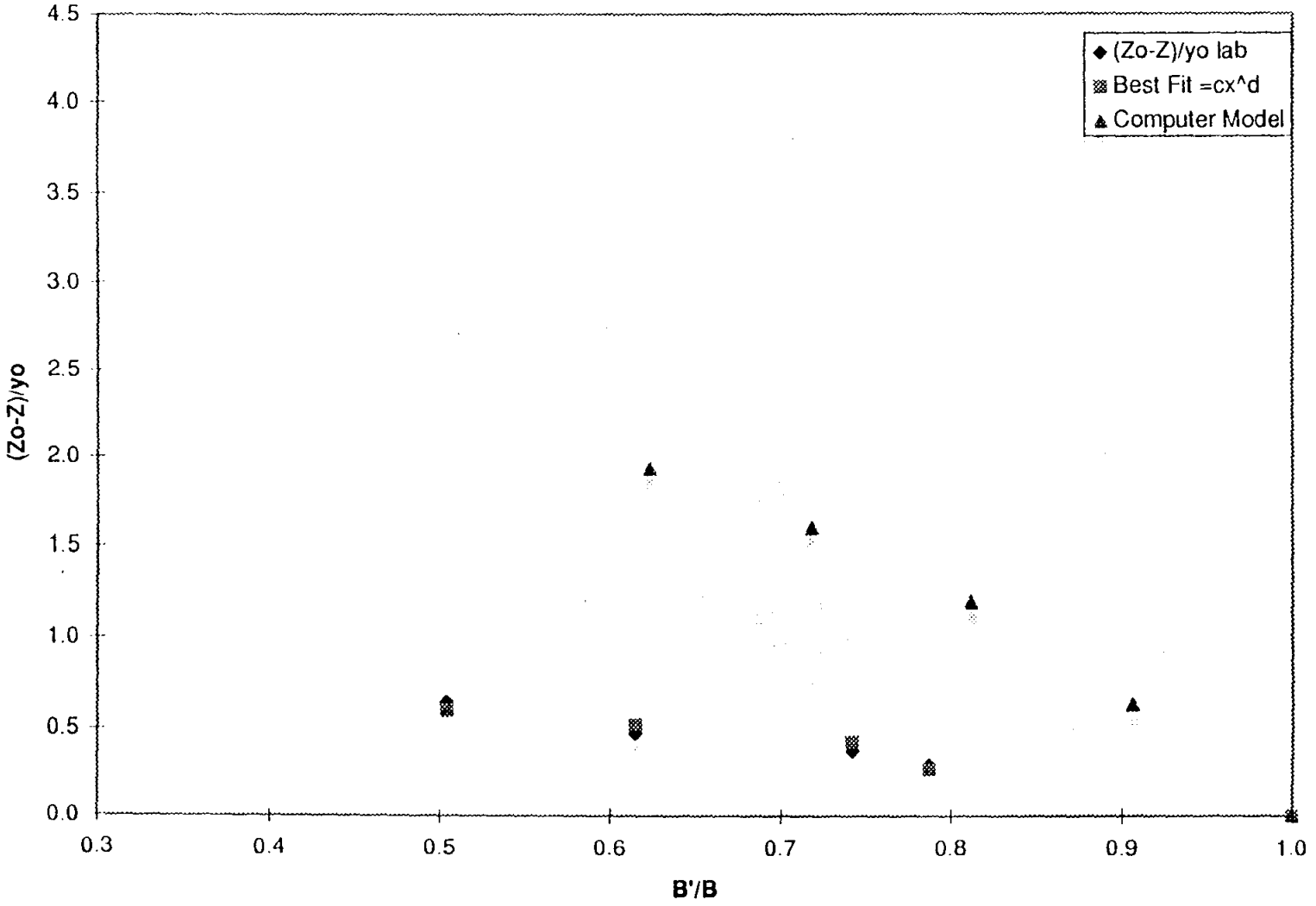
Graph 1


4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
(Zo-Z)/yo
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
B'/B
(Zo-Z)/yo lab
Best Fit y=cx^d
Computer Model
Eq 5.17
Eq 5.19

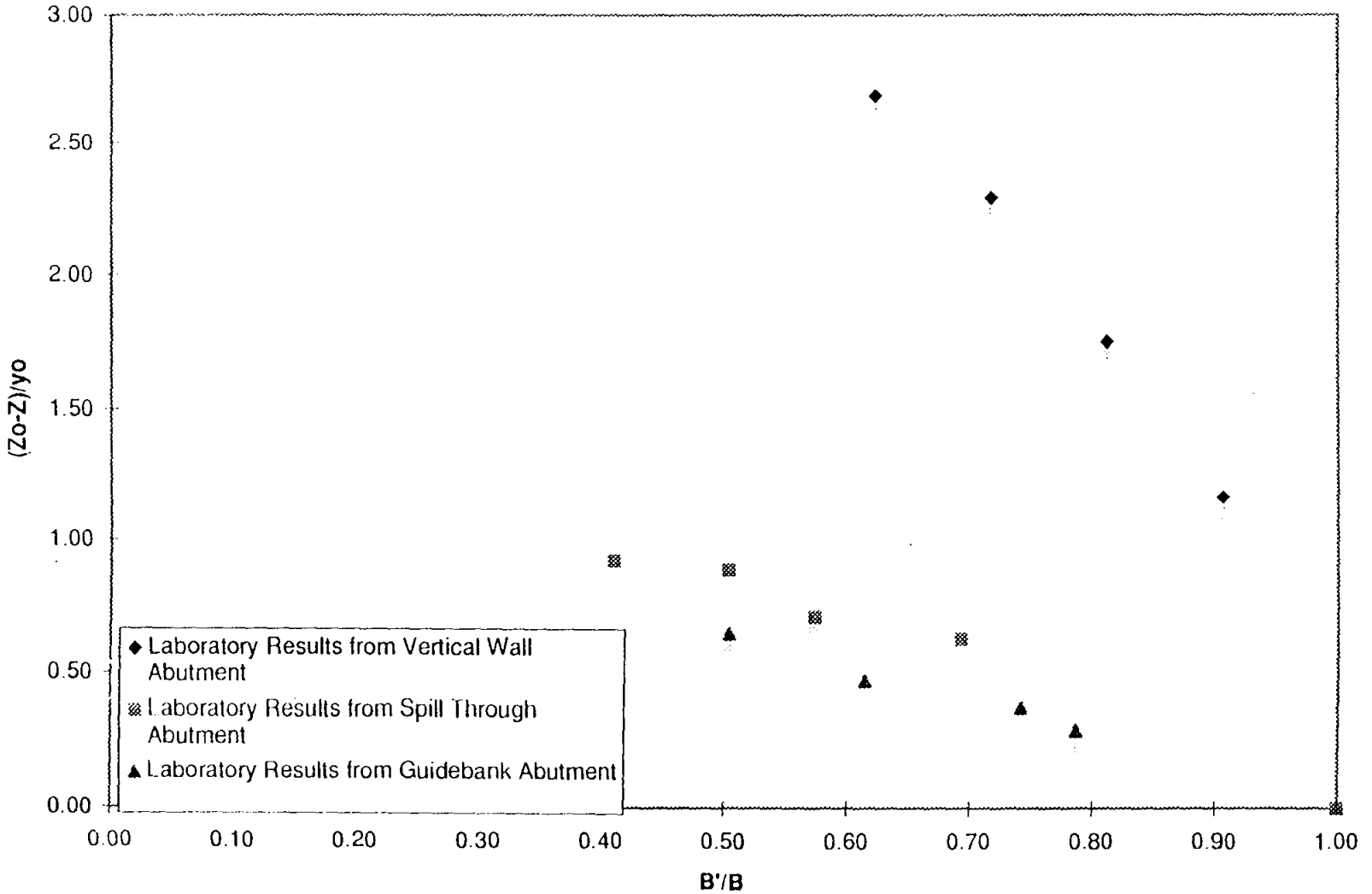
Graph 2


4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
(Zo-Z)/yo
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
B'/B
(Zo-Z)/yo lab
Eqn 5.16
Best fit y=cx^d
Computer Model

Graph 3


(Zo-Z)/yo lab
Best Fit =cx^d
Computer Model
(Zo-Z)/yo
B'/B
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

Graph 4 Comparison of Laboratory Results



APPENDIX D

LAPLACE EQUATION STREAMLINE SOLUTION FOR VARIOUS ABUTMENT CONFIGURATION

Figure 1a (1)

Global view of vertical wall abutment B'/B = 0.91

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Expanded view of vertical wall abutment B'/B = 0.91 [scale 5:1]

	A					B					C					D					E
19	1.00	1.16	1.33	1.49	1.65	1.82	2.01	2.20	2.38	2.57	2.76	2.96	3.16	3.36	3.57	3.77	3.97	4.18	4.38	4.59	4.79
	1.00	1.15	1.31	1.47	1.63	1.80	1.98	2.16	2.35	2.55	2.74	2.94	3.14	3.34	3.55	3.75	3.96	4.16	4.37	4.57	4.78
	1.00	1.14	1.29	1.44	1.60	1.77	1.95	2.13	2.32	2.51	2.71	2.91	3.12	3.32	3.53	3.73	3.94	4.15	4.36	4.56	4.77
	1.00	1.13	1.26	1.41	1.56	1.73	1.90	2.09	2.28	2.48	2.68	2.89	3.09	3.30	3.51	3.71	3.92	4.13	4.34	4.55	4.76
	1.00	1.11	1.23	1.36	1.51	1.68	1.86	2.05	2.24	2.44	2.65	2.86	3.06	3.27	3.49	3.70	3.91	4.12	4.33	4.54	4.75
20	1.00	1.07	1.17	1.30	1.45	1.61	1.80	1.99	2.19	2.40	2.61	2.82	3.04	3.25	3.46	3.68	3.89	4.10	4.32	4.53	4.74
		1.00	1.10	1.23	1.37	1.54	1.73	1.93	2.14	2.36	2.57	2.79	3.01	3.23	3.44	3.66	3.88	4.09	4.30	4.52	4.73
			1.00	1.13	1.28	1.45	1.65	1.87	2.09	2.31	2.53	2.76	2.98	3.20	3.42	3.64	3.86	4.08	4.29	4.51	4.72
				1.00	1.16	1.34	1.56	1.79	2.03	2.26	2.49	2.72	2.95	3.18	3.40	3.62	3.85	4.07	4.28	4.50	4.72
					1.00	1.20	1.46	1.72	1.97	2.21	2.45	2.69	2.93	3.16	3.38	3.61	3.83	4.05	4.27	4.49	4.71
21						1.00	1.36	1.65	1.92	2.17	2.40	2.66	2.91	3.14	3.37	3.59	3.82	4.05	4.27	4.49	4.70
						1.00	1.32	1.62	1.89	2.15	2.40	2.65	2.89	3.13	3.36	3.59	3.82	4.04	4.26	4.48	4.70
						1.00	1.31	1.60	1.88	2.14	2.40	2.64	2.89	3.13	3.36	3.59	3.81	4.04	4.26	4.48	4.70
						1.00	1.31	1.60	1.88	2.14	2.40	2.64	2.89	3.13	3.36	3.59	3.81	4.04	4.26	4.48	4.70
						1.00	1.32	1.62	1.89	2.15	2.40	2.65	2.89	3.13	3.36	3.59	3.82	4.04	4.26	4.48	4.70
22						1.00	1.36	1.65	1.92	2.17	2.40	2.66	2.91	3.14	3.37	3.59	3.82	4.05	4.27	4.49	4.70
					1.00	1.20	1.46	1.72	1.97	2.21	2.45	2.69	2.93	3.16	3.38	3.61	3.83	4.05	4.27	4.49	4.71
				1.00	1.16	1.34	1.56	1.79	2.03	2.26	2.49	2.72	2.95	3.18	3.40	3.62	3.85	4.07	4.28	4.50	4.72
			1.00	1.13	1.28	1.45	1.65	1.87	2.09	2.31	2.53	2.76	2.98	3.20	3.42	3.64	3.86	4.08	4.29	4.51	4.72
		1.00	1.10	1.23	1.37	1.54	1.73	1.93	2.14	2.36	2.57	2.79	3.01	3.23	3.44	3.66	3.88	4.09	4.30	4.52	4.73
23	1.00	1.07	1.17	1.30	1.45	1.61	1.80	1.99	2.19	2.40	2.61	2.82	3.04	3.25	3.46	3.68	3.89	4.10	4.32	4.53	4.74
	1.00	1.11	1.23	1.36	1.51	1.68	1.86	2.05	2.24	2.44	2.65	2.86	3.06	3.27	3.49	3.70	3.91	4.12	4.33	4.54	4.75
	1.00	1.13	1.26	1.41	1.56	1.73	1.90	2.09	2.28	2.48	2.68	2.89	3.09	3.30	3.51	3.71	3.92	4.13	4.34	4.55	4.76
	1.00	1.14	1.29	1.44	1.60	1.77	1.95	2.13	2.32	2.51	2.71	2.91	3.12	3.32	3.53	3.73	3.94	4.15	4.36	4.56	4.77
	1.00	1.15	1.31	1.47	1.63	1.80	1.98	2.16	2.35	2.55	2.74	2.94	3.14	3.34	3.55	3.75	3.96	4.16	4.37	4.57	4.78
24	1.00	1.16	1.33	1.49	1.65	1.82	2.01	2.20	2.38	2.57	2.76	2.96	3.16	3.36	3.57	3.77	3.97	4.18	4.38	4.59	4.79

Figure 1b (1)

Global view of vertical wall abutment B'/B = 0.8125

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.98	4.97	5.97	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.94	5.93	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.89	9.89	10.91	11.92	12.94	13.96	14.98	16.00
1.00	1.96	2.93	3.90	4.88	5.86	6.85	7.85	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.81	7.81	8.82	9.84	10.86	11.88	12.91	13.94	14.97	16.00
1.00	1.94	2.88	3.83	4.80	5.78	6.77	7.77	8.78	9.80	10.83	11.86	12.89	13.93	14.96	16.00
1.00	1.92	2.84	3.78	4.74	5.72	6.71	7.72	8.73	9.76	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.89	2.79	3.71	4.66	5.64	6.64	7.65	8.68	9.71	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.84	2.71	3.62	4.56	5.54	6.55	7.57	8.61	9.66	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.77	2.60	3.48	4.42	5.41	6.44	7.48	8.54	9.60	10.67	11.73	12.80	13.87	14.93	16.00
1.00	1.66	2.42	3.28	4.24	5.26	6.31	7.38	8.46	9.54	10.62	11.70	12.78	13.85	14.93	16.00
1.00	1.45	2.14	3.00	3.99	5.06	6.16	7.27	8.38	9.48	10.58	11.67	12.75	13.84	14.92	16.00
1.00	1.00	1.68	2.58	3.67	4.83	6.00	7.16	8.30	9.42	10.54	11.64	12.74	13.83	14.91	16.00
1.00	1.00	1.00	1.97	3.29	4.60	5.86	7.07	8.24	9.38	10.51	11.62	12.72	13.82	14.91	16.00
1.00	1.00	1.00	1.00	2.90	4.42	5.76	7.01	8.20	9.36	10.49	11.61	12.71	13.81	14.91	16.00
1.00	1.00	1.00	1.00	2.90	4.42	5.76	7.01	8.20	9.36	10.49	11.61	12.71	13.81	14.91	16.00
1.00	1.00	1.00	1.97	3.29	4.60	5.86	7.07	8.24	9.38	10.51	11.62	12.72	13.82	14.91	16.00
1.00	1.00	1.68	2.58	3.67	4.83	6.00	7.16	8.30	9.42	10.54	11.64	12.74	13.83	14.91	16.00
1.00	1.45	2.14	3.00	3.99	5.06	6.16	7.27	8.38	9.48	10.58	11.67	12.75	13.84	14.92	16.00
1.00	1.66	2.42	3.28	4.24	5.26	6.31	7.38	8.46	9.54	10.62	11.70	12.78	13.85	14.93	16.00
1.00	1.77	2.60	3.48	4.42	5.41	6.44	7.48	8.54	9.60	10.67	11.73	12.80	13.87	14.93	16.00
1.00	1.84	2.71	3.62	4.56	5.54	6.55	7.57	8.61	9.66	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.89	2.79	3.71	4.66	5.64	6.64	7.65	8.68	9.71	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.92	2.84	3.78	4.74	5.72	6.71	7.72	8.73	9.76	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.94	2.88	3.83	4.80	5.78	6.77	7.77	8.78	9.80	10.83	11.86	12.89	13.93	14.96	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.81	7.81	8.82	9.84	10.86	11.88	12.91	13.94	14.97	16.00
1.00	1.96	2.93	3.90	4.88	5.86	6.85	7.85	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.89	9.89	10.91	11.92	12.94	13.96	14.98	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.98	2.97	3.95	4.94	5.93	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.98	3.98	4.97	5.97	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 18 (2)

Expanded view of vertical wall abutment B'/B = 0.8125 [scale 5:1]

	C					D					E					F					G
19	1.68	1.86	2.04	2.22	2.40	2.58	2.80	3.02	3.24	3.45	3.67	3.90	4.14	4.37	4.60	4.83	5.07	5.30	5.54	5.77	6.00
	1.54	1.73	1.91	2.10	2.29	2.49	2.70	2.92	3.15	3.37	3.60	3.84	4.07	4.31	4.55	4.79	5.02	5.26	5.50	5.74	5.97
	1.41	1.59	1.78	1.97	2.17	2.38	2.59	2.82	3.05	3.29	3.53	3.77	4.01	4.25	4.50	4.74	4.98	5.22	5.46	5.71	5.95
	1.27	1.46	1.64	1.84	2.04	2.25	2.48	2.72	2.96	3.20	3.45	3.70	3.95	4.19	4.44	4.69	4.94	5.18	5.43	5.67	5.92
	1.14	1.31	1.50	1.70	1.90	2.12	2.36	2.61	2.86	3.11	3.37	3.62	3.88	4.14	4.39	4.65	4.90	5.15	5.40	5.64	5.89
20	1.00	1.17	1.35	1.55	1.75	1.97	2.23	2.49	2.76	3.02	3.29	3.55	3.82	4.08	4.34	4.60	4.86	5.11	5.36	5.61	5.86
		1.00	1.18	1.38	1.60	1.84	2.10	2.37	2.65	2.93	3.21	3.48	3.76	4.03	4.29	4.56	4.82	5.08	5.33	5.59	5.84
			1.00	1.20	1.43	1.68	1.96	2.25	2.55	2.84	3.13	3.41	3.70	3.98	4.25	4.52	4.79	5.05	5.31	5.57	5.82
				1.00	1.23	1.51	1.81	2.13	2.44	2.75	3.05	3.35	3.64	3.93	4.21	4.48	4.75	5.02	5.28	5.54	5.80
					1.00	1.29	1.65	2.01	2.35	2.67	2.98	3.29	3.60	3.89	4.17	4.45	4.73	5.00	5.26	5.53	5.78
21						1.00	1.50	1.91	2.27	2.60	2.90	3.24	3.56	3.86	4.15	4.42	4.71	4.98	5.25	5.51	5.76
						1.00	1.44	1.85	2.22	2.57	2.89	3.22	3.53	3.84	4.13	4.41	4.69	4.97	5.24	5.50	5.76
						1.00	1.42	1.82	2.20	2.55	2.88	3.21	3.52	3.83	4.12	4.41	4.69	4.96	5.23	5.50	5.76
						1.00	1.42	1.82	2.20	2.55	2.88	3.21	3.52	3.83	4.12	4.41	4.69	4.96	5.23	5.50	5.76
						1.00	1.44	1.85	2.22	2.57	2.89	3.22	3.53	3.84	4.13	4.41	4.69	4.97	5.24	5.50	5.76
22						1.00	1.50	1.91	2.27	2.60	2.90	3.24	3.56	3.86	4.15	4.42	4.71	4.98	5.25	5.51	5.76
					1.00	1.29	1.65	2.01	2.35	2.67	2.98	3.29	3.60	3.89	4.17	4.45	4.73	5.00	5.26	5.53	5.78
				1.00	1.23	1.51	1.81	2.13	2.44	2.75	3.05	3.35	3.64	3.93	4.21	4.48	4.75	5.02	5.28	5.54	5.80
			1.00	1.20	1.43	1.68	1.96	2.25	2.55	2.84	3.13	3.41	3.70	3.98	4.25	4.52	4.79	5.05	5.31	5.57	5.82
		1.00	1.18	1.38	1.60	1.84	2.10	2.37	2.65	2.93	3.21	3.48	3.76	4.03	4.29	4.56	4.82	5.08	5.33	5.59	5.84
23	1.00	1.17	1.35	1.55	1.75	1.97	2.23	2.49	2.75	3.02	3.29	3.55	3.82	4.08	4.34	4.60	4.86	5.11	5.36	5.61	5.86
	1.14	1.31	1.50	1.70	1.90	2.12	2.36	2.61	2.86	3.11	3.37	3.62	3.88	4.14	4.39	4.65	4.90	5.15	5.40	5.64	5.89
	1.27	1.46	1.64	1.84	2.04	2.25	2.48	2.72	2.96	3.20	3.45	3.70	3.95	4.19	4.44	4.69	4.94	5.18	5.43	5.67	5.92
	1.41	1.59	1.78	1.97	2.17	2.38	2.59	2.82	3.05	3.29	3.53	3.77	4.01	4.25	4.50	4.74	4.98	5.22	5.46	5.71	5.95
	1.54	1.73	1.91	2.10	2.29	2.49	2.70	2.92	3.15	3.37	3.60	3.84	4.07	4.31	4.55	4.79	5.02	5.26	5.50	5.74	5.97
24	1.68	1.86	2.04	2.22	2.40	2.58	2.80	3.02	3.24	3.45	3.67	3.90	4.14	4.37	4.60	4.83	5.07	5.30	5.54	5.77	6.00

Figure 1c (1)

Global view of vertical wall abutment B'/B = 0.72

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.93	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.95	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.92	12.93	13.96	14.98	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.85	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.92	2.84	3.78	4.73	5.70	6.69	7.69	8.70	9.72	10.76	11.80	12.85	13.89	14.95	16.00
1.00	1.89	2.80	3.72	4.66	5.62	6.61	7.61	8.63	9.66	10.71	11.76	12.81	13.87	14.94	16.00
1.00	1.86	2.73	3.63	4.56	5.52	6.51	7.52	8.55	9.59	10.65	11.71	12.78	13.85	14.93	16.00
1.00	1.81	2.65	3.52	4.44	5.39	6.39	7.41	8.45	9.51	10.58	11.66	12.74	13.83	14.91	16.00
1.00	1.74	2.52	3.36	4.27	5.23	6.24	7.28	8.34	9.42	10.51	11.60	12.70	13.80	14.90	16.00
1.00	1.62	2.33	3.14	4.04	5.02	6.05	7.12	8.21	9.32	10.43	11.54	12.66	13.77	14.89	16.00
1.00	1.42	2.05	2.83	3.74	4.75	5.83	6.94	8.07	9.21	10.35	11.48	12.62	13.75	14.87	16.00
1.00	1.00	1.61	2.40	3.35	4.42	5.57	6.75	7.93	9.10	10.27	11.43	12.58	13.72	14.86	16.00
1.00	1.00	1.00	1.80	2.82	4.02	5.28	6.55	7.79	9.00	10.20	11.38	12.54	13.70	14.85	16.00
1.00	1.00	1.00	1.00	2.09	3.56	5.00	6.37	7.67	8.92	10.14	11.34	12.52	13.68	14.84	16.00
1.00	1.00	1.00	1.00	1.00	3.11	4.79	6.25	7.60	8.88	10.11	11.32	12.50	13.68	14.84	16.00
1.00	1.00	1.00	1.00	1.00	3.11	4.79	6.25	7.60	8.88	10.11	11.32	12.50	13.68	14.84	16.00
1.00	1.00	1.00	1.00	2.09	3.56	5.00	6.37	7.67	8.92	10.14	11.34	12.52	13.68	14.84	16.00
1.00	1.00	1.00	1.80	2.82	4.02	5.28	6.55	7.79	9.00	10.20	11.38	12.54	13.70	14.85	16.00
1.00	1.00	1.61	2.40	3.35	4.42	5.57	6.75	7.93	9.10	10.27	11.43	12.58	13.72	14.86	16.00
1.00	1.42	2.05	2.83	3.74	4.75	5.83	6.94	8.07	9.21	10.35	11.48	12.62	13.75	14.87	16.00
1.00	1.62	2.33	3.14	4.04	5.02	6.05	7.12	8.21	9.32	10.43	11.54	12.66	13.77	14.89	16.00
1.00	1.74	2.52	3.36	4.27	5.23	6.24	7.28	8.34	9.42	10.51	11.60	12.70	13.80	14.90	16.00
1.00	1.81	2.65	3.52	4.44	5.39	6.39	7.41	8.45	9.51	10.58	11.66	12.74	13.83	14.91	16.00
1.00	1.86	2.73	3.63	4.56	5.52	6.51	7.52	8.55	9.59	10.65	11.71	12.78	13.85	14.93	16.00
1.00	1.89	2.80	3.72	4.66	5.62	6.61	7.61	8.63	9.66	10.71	11.76	12.81	13.87	14.94	16.00
1.00	1.92	2.84	3.78	4.73	5.70	6.69	7.69	8.70	9.72	10.76	11.80	12.85	13.89	14.95	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.85	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.97	2.95	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.92	12.93	13.96	14.98	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.93	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.98	14.99	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Expanded view of vertical wall abutment B'/B = 0.72 [scale 5:1]

	D					E					F					G					H
19	1.80	2.01	2.21	2.41	2.61	2.82	3.06	3.30	3.54	3.78	4.02	4.27	4.52	4.78	5.03	5.28	5.54	5.79	6.04	6.29	6.55
	1.64	1.85	2.06	2.27	2.48	2.70	2.94	3.18	3.43	3.68	3.93	4.19	4.45	4.71	4.97	5.22	5.48	5.74	6.00	6.25	6.51
	1.48	1.69	1.90	2.12	2.34	2.57	2.81	3.06	3.32	3.58	3.84	4.11	4.37	4.64	4.90	5.17	5.43	5.69	5.95	6.21	6.47
	1.32	1.53	1.74	1.96	2.19	2.43	2.68	2.94	3.21	3.48	3.75	4.02	4.29	4.57	4.84	5.11	5.38	5.64	5.91	6.17	6.44
	1.16	1.36	1.58	1.80	2.03	2.27	2.54	2.81	3.09	3.37	3.65	3.93	4.22	4.50	4.78	5.05	5.33	5.60	5.87	6.14	6.40
20	1.00	1.19	1.40	1.62	1.86	2.09	2.39	2.68	2.97	3.26	3.56	3.85	4.14	4.43	4.72	5.00	5.28	5.56	5.83	6.10	6.37
		1.00	1.21	1.44	1.68	1.95	2.24	2.54	2.85	3.16	3.46	3.77	4.07	4.37	4.66	4.95	5.23	5.52	5.80	6.07	6.34
			1.00	1.23	1.49	1.77	2.08	2.40	2.73	3.05	3.37	3.69	4.00	4.31	4.61	4.90	5.19	5.48	5.76	6.04	6.32
				1.00	1.26	1.57	1.91	2.26	2.61	2.95	3.29	3.62	3.94	4.25	4.56	4.86	5.16	5.45	5.73	6.02	6.30
					1.00	1.32	1.73	2.13	2.50	2.86	3.20	3.55	3.88	4.21	4.52	4.82	5.13	5.42	5.71	5.99	6.27
21						1.00	1.56	2.01	2.41	2.78	3.11	3.49	3.84	4.17	4.49	4.79	5.10	5.40	5.69	5.98	6.25
						1.00	1.49	1.94	2.36	2.74	3.10	3.46	3.81	4.15	4.47	4.78	5.09	5.39	5.68	5.97	6.25
						1.00	1.47	1.91	2.33	2.72	3.09	3.45	3.80	4.13	4.46	4.77	5.08	5.38	5.67	5.96	6.25
						1.00	1.47	1.91	2.33	2.72	3.09	3.45	3.80	4.13	4.46	4.77	5.08	5.38	5.67	5.96	6.25
						1.00	1.49	1.94	2.36	2.74	3.10	3.46	3.81	4.15	4.47	4.78	5.09	5.39	5.68	5.97	6.25
22						1.00	1.56	2.01	2.41	2.78	3.11	3.49	3.84	4.17	4.49	4.79	5.10	5.40	5.69	5.98	6.25
					1.00	1.32	1.73	2.13	2.50	2.86	3.20	3.55	3.88	4.21	4.52	4.82	5.13	5.42	5.71	5.99	6.27
				1.00	1.26	1.57	1.91	2.26	2.61	2.95	3.29	3.62	3.94	4.25	4.56	4.86	5.16	5.45	5.73	6.02	6.30
			1.00	1.23	1.49	1.77	2.08	2.40	2.73	3.05	3.37	3.69	4.00	4.31	4.61	4.90	5.19	5.48	5.76	6.04	6.32
		1.00	1.21	1.44	1.68	1.95	2.24	2.54	2.85	3.16	3.46	3.77	4.07	4.37	4.66	4.95	5.23	5.52	5.80	6.07	6.34
23	1.00	1.19	1.40	1.62	1.86	2.09	2.39	2.68	2.97	3.26	3.56	3.85	4.14	4.43	4.72	5.00	5.28	5.56	5.83	6.10	6.37
	1.16	1.36	1.58	1.80	2.03	2.27	2.54	2.81	3.09	3.37	3.65	3.93	4.22	4.50	4.78	5.05	5.33	5.60	5.87	6.14	6.40
	1.32	1.53	1.74	1.96	2.19	2.43	2.68	2.94	3.21	3.48	3.75	4.02	4.29	4.57	4.84	5.11	5.38	5.64	5.91	6.17	6.44
	1.48	1.69	1.90	2.12	2.34	2.57	2.81	3.06	3.32	3.58	3.84	4.11	4.37	4.64	4.90	5.17	5.43	5.69	5.95	6.21	6.47
	1.64	1.85	2.06	2.27	2.48	2.70	2.94	3.18	3.43	3.68	3.93	4.19	4.45	4.71	4.97	5.22	5.48	5.74	6.00	6.25	6.51
24	1.80	2.01	2.21	2.41	2.61	2.82	3.06	3.30	3.54	3.78	4.02	4.27	4.52	4.78	5.03	5.28	5.54	5.79	6.04	6.29	6.55

Figure 1d (1)

Global view of vertical wall abutment B'/B = 0.625

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.96	2.91	3.88	4.85	5.82	6.81	7.80	8.81	9.82	10.84	11.86	12.89	13.93	14.96	16.00
1.00	1.94	2.88	3.83	4.79	5.76	6.75	7.74	8.74	9.76	10.79	11.82	12.86	13.90	14.95	16.00
1.00	1.92	2.85	3.78	4.73	5.69	6.67	7.66	8.67	9.69	10.73	11.77	12.82	13.88	14.94	16.00
1.00	1.90	2.80	3.72	4.65	5.61	6.58	7.57	8.58	9.61	10.65	11.71	12.77	13.85	14.92	16.00
1.00	1.87	2.74	3.64	4.56	5.50	6.47	7.46	8.48	9.52	10.57	11.64	12.72	13.81	14.90	16.00
1.00	1.83	2.67	3.54	4.43	5.37	6.33	7.33	8.36	9.41	10.48	11.56	12.66	13.77	14.88	16.00
1.00	1.77	2.57	3.40	4.28	5.20	6.16	7.17	8.21	9.27	10.36	11.47	12.59	13.72	14.86	16.00
1.00	1.70	2.43	3.23	4.08	4.99	5.96	6.97	8.03	9.12	10.23	11.37	12.52	13.67	14.83	16.00
1.00	1.58	2.21	2.99	3.82	4.73	5.70	6.74	7.82	8.94	10.08	11.25	12.43	13.61	14.81	16.00
1.00	1.39	1.96	2.67	3.48	4.39	5.39	6.45	7.57	8.73	9.91	11.12	12.33	13.55	14.78	16.00
1.00	1.00	1.55	2.24	3.05	3.98	5.00	6.11	7.28	8.49	9.73	10.98	12.23	13.49	14.74	16.00
1.00	1.00	1.00	1.69	2.51	3.46	4.53	5.71	6.95	8.23	9.53	10.83	12.13	13.42	14.71	16.00
1.00	1.00	1.00	1.00	1.83	2.82	3.96	5.24	6.59	7.96	9.33	10.68	12.03	13.36	14.68	16.00
1.00	1.00	1.00	1.00	1.00	2.02	3.26	4.70	6.20	7.69	9.14	10.55	11.94	13.30	14.66	16.00
1.00	1.00	1.00	1.00	1.00	1.00	2.34	4.11	5.83	7.45	8.98	10.45	11.87	13.26	14.64	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.56	5.56	7.30	8.89	10.39	11.84	13.24	14.63	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.56	5.56	7.30	8.89	10.39	11.84	13.24	14.63	16.00
1.00	1.00	1.00	1.00	1.00	1.00	2.34	4.11	5.83	7.45	8.98	10.45	11.87	13.26	14.64	16.00
1.00	1.00	1.00	1.00	1.00	2.02	3.26	4.70	6.20	7.69	9.14	10.55	11.94	13.30	14.66	16.00
1.00	1.00	1.00	1.00	1.83	2.82	3.96	5.24	6.59	7.96	9.33	10.68	12.03	13.36	14.68	16.00
1.00	1.00	1.00	1.69	2.51	3.46	4.53	5.71	6.95	8.23	9.53	10.83	12.13	13.42	14.71	16.00
1.00	1.00	1.55	2.24	3.05	3.98	5.00	6.11	7.28	8.49	9.73	10.98	12.23	13.49	14.74	16.00
1.00	1.39	1.96	2.67	3.48	4.39	5.39	6.45	7.57	8.73	9.91	11.12	12.33	13.55	14.78	16.00
1.00	1.58	2.24	2.99	3.82	4.73	5.70	6.74	7.82	8.94	10.08	11.25	12.43	13.61	14.81	16.00
1.00	1.70	2.43	3.23	4.08	4.99	5.96	6.97	8.03	9.12	10.23	11.37	12.52	13.67	14.83	16.00
1.00	1.77	2.57	3.40	4.28	5.20	6.16	7.17	8.21	9.27	10.36	11.47	12.59	13.72	14.86	16.00
1.00	1.83	2.67	3.54	4.43	5.37	6.33	7.33	8.36	9.41	10.48	11.56	12.66	13.77	14.88	16.00
1.00	1.87	2.74	3.64	4.56	5.50	6.47	7.46	8.48	9.52	10.57	11.64	12.72	13.81	14.90	16.00
1.00	1.90	2.80	3.72	4.65	5.61	6.58	7.57	8.58	9.61	10.65	11.71	12.77	13.85	14.92	16.00
1.00	1.92	2.85	3.78	4.73	5.69	6.67	7.66	8.67	9.69	10.73	11.77	12.82	13.88	14.94	16.00
1.00	1.94	2.88	3.83	4.79	5.76	6.75	7.74	8.74	9.76	10.79	11.82	12.86	13.90	14.95	16.00
1.00	1.96	2.91	3.88	4.85	5.82	6.81	7.80	8.81	9.82	10.84	11.86	12.89	13.93	14.96	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 1d (2)

Expanded view of vertical wall abutment B'/B = 0.625 [scale 5:1]

	F					G					H					I					J
19	2.02	2.27	2.51	2.76	3.01	3.26	3.54	3.83	4.12	4.41	4.70	5.00	5.30	5.60	5.90	6.20	6.50	6.80	7.09	7.39	7.69
	1.81	2.07	2.32	2.58	2.84	3.11	3.39	3.69	3.98	4.28	4.59	4.89	5.20	5.51	5.82	6.12	6.43	6.73	7.04	7.34	7.64
	1.61	1.87	2.12	2.39	2.66	2.94	3.23	3.54	3.84	4.16	4.47	4.79	5.10	5.42	5.73	6.05	6.36	6.67	6.98	7.29	7.59
	1.41	1.66	1.92	2.19	2.47	2.76	3.06	3.38	3.70	4.02	4.35	4.68	5.00	5.33	5.65	5.97	6.29	6.61	6.92	7.24	7.55
	1.20	1.45	1.71	1.98	2.27	2.56	2.88	3.22	3.55	3.89	4.23	4.57	4.90	5.24	5.57	5.90	6.23	6.55	6.87	7.19	7.50
20	1.00	1.24	1.49	1.77	2.05	2.34	2.70	3.05	3.40	3.76	4.11	4.46	4.81	5.15	5.49	5.83	6.16	6.49	6.82	7.14	7.45
		1.00	1.26	1.54	1.83	2.16	2.51	2.88	3.25	3.62	3.99	4.36	4.72	5.07	5.42	5.77	6.11	6.44	6.77	7.10	7.42
			1.00	1.28	1.59	1.94	2.32	2.71	3.10	3.49	3.88	4.26	4.63	5.00	5.36	5.71	6.05	6.40	6.73	7.06	7.39
				1.00	1.32	1.69	2.11	2.53	2.96	3.37	3.77	4.16	4.55	4.93	5.30	5.65	6.01	6.35	6.70	7.03	7.36
					1.00	1.39	1.89	2.37	2.82	3.25	3.66	4.08	4.48	4.87	5.24	5.61	5.97	6.32	6.66	7.00	7.33
21						1.00	1.68	2.22	2.71	3.16	3.56	4.01	4.43	4.82	5.20	5.56	5.94	6.29	6.64	6.98	7.30
						1.00	1.60	2.14	2.64	3.11	3.54	3.98	4.39	4.79	5.18	5.55	5.92	6.28	6.62	6.97	7.30
						1.00	1.57	2.11	2.61	3.08	3.53	3.96	4.38	4.78	5.17	5.54	5.91	6.27	6.62	6.96	7.30
						1.00	1.57	2.11	2.61	3.08	3.53	3.96	4.38	4.78	5.17	5.54	5.91	6.27	6.62	6.96	7.30
						1.00	1.60	2.14	2.64	3.11	3.54	3.98	4.39	4.79	5.18	5.55	5.92	6.28	6.62	6.97	7.30
22						1.00	1.68	2.22	2.71	3.16	3.56	4.01	4.43	4.82	5.20	5.56	5.94	6.29	6.64	6.98	7.30
					1.00	1.39	1.89	2.37	2.82	3.25	3.66	4.08	4.48	4.87	5.24	5.61	5.97	6.32	6.66	7.00	7.33
				1.00	1.32	1.69	2.11	2.53	2.96	3.37	3.77	4.16	4.55	4.93	5.30	5.65	6.01	6.35	6.70	7.03	7.36
			1.00	1.28	1.59	1.94	2.32	2.71	3.10	3.49	3.88	4.26	4.63	5.00	5.36	5.71	6.05	6.40	6.73	7.06	7.39
		1.00	1.26	1.54	1.83	2.16	2.51	2.88	3.25	3.62	3.99	4.36	4.72	5.07	5.42	5.77	6.11	6.44	6.77	7.10	7.42
23	1.00	1.24	1.49	1.77	2.05	2.34	2.70	3.05	3.40	3.76	4.11	4.46	4.81	5.15	5.49	5.83	6.16	6.49	6.82	7.14	7.45
	1.20	1.45	1.71	1.98	2.27	2.56	2.88	3.22	3.55	3.89	4.23	4.57	4.90	5.24	5.57	5.90	6.23	6.55	6.87	7.19	7.50
	1.41	1.66	1.92	2.19	2.47	2.76	3.06	3.38	3.70	4.02	4.35	4.68	5.00	5.33	5.65	5.97	6.29	6.61	6.92	7.24	7.55
	1.61	1.87	2.12	2.39	2.66	2.94	3.23	3.54	3.84	4.16	4.47	4.79	5.10	5.42	5.73	6.05	6.36	6.67	6.98	7.29	7.59
	1.81	2.07	2.32	2.58	2.84	3.11	3.39	3.69	3.98	4.28	4.59	4.89	5.20	5.51	5.82	6.12	6.43	6.73	7.04	7.34	7.64
24	2.02	2.27	2.51	2.76	3.01	3.26	3.54	3.83	4.12	4.41	4.70	5.00	5.30	5.60	5.90	6.20	6.50	6.80	7.09	7.39	7.69

Figure 2a (1)

Global view of spill through abutment B'/B = 0.91

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 2a (=)

Expanded view of spill through abutment B'/B = 0.91 [scale 5:1]

	A					B					C					D					E
20	1.00	1.12	1.24	1.36	1.49	1.61	1.81	2.01	2.21	2.41	2.61	2.83	3.04	3.25	3.46	3.68	3.89	4.10	4.31	4.53	4.74
	1.00	1.10	1.21	1.33	1.46	1.60	1.78	1.98	2.18	2.38	2.59	2.80	3.01	3.23	3.45	3.66	3.88	4.09	4.30	4.52	4.73
	1.00	1.06	1.16	1.28	1.41	1.57	1.75	1.94	2.14	2.34	2.55	2.77	2.99	3.21	3.43	3.64	3.86	4.08	4.29	4.51	4.72
	1.00	1.00	1.09	1.21	1.35	1.51	1.70	1.89	2.10	2.30	2.52	2.74	2.96	3.19	3.41	3.63	3.85	4.07	4.28	4.50	4.72
	1.00	1.00	1.00	1.12	1.26	1.44	1.63	1.84	2.05	2.26	2.47	2.71	2.94	3.17	3.39	3.61	3.83	4.06	4.28	4.49	4.71
21	1.00	1.00	1.00	1.00	1.15	1.33	1.55	1.78	2.00	2.22	2.40	2.67	2.92	3.15	3.38	3.59	3.82	4.05	4.27	4.49	4.70
	1.00	1.00	1.00	1.00	1.00	1.20	1.47	1.73	1.97	2.20	2.42	2.67	2.91	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
	1.00	1.00	1.00	1.00	1.00	1.00	1.38	1.69	1.95	2.19	2.43	2.67	2.90	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
	1.00	1.00	1.00	1.00	1.00	1.00	1.38	1.69	1.95	2.19	2.43	2.67	2.90	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
	1.00	1.00	1.00	1.00	1.00	1.20	1.47	1.73	1.97	2.20	2.42	2.67	2.91	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
22	1.00	1.00	1.00	1.00	1.15	1.33	1.55	1.78	2.00	2.22	2.40	2.67	2.92	3.15	3.38	3.59	3.82	4.05	4.27	4.49	4.70
	1.00	1.00	1.00	1.12	1.26	1.44	1.63	1.84	2.05	2.26	2.47	2.71	2.94	3.17	3.39	3.61	3.83	4.06	4.28	4.49	4.71
	1.00	1.00	1.09	1.21	1.35	1.51	1.70	1.89	2.10	2.30	2.52	2.74	2.96	3.19	3.41	3.63	3.85	4.07	4.28	4.50	4.72
	1.00	1.06	1.16	1.28	1.41	1.57	1.75	1.94	2.14	2.34	2.55	2.77	2.99	3.21	3.43	3.64	3.86	4.08	4.29	4.51	4.72
	1.00	1.10	1.21	1.33	1.46	1.60	1.78	1.98	2.18	2.38	2.59	2.80	3.01	3.23	3.45	3.66	3.88	4.09	4.30	4.52	4.73
23	1.00	1.12	1.24	1.36	1.49	1.61	1.81	2.01	2.21	2.41	2.61	2.83	3.04	3.25	3.46	3.68	3.89	4.10	4.31	4.53	4.74

Figure 2b (1)

Global view of spill through abutment B'/B = 0.8125

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.98	4.97	5.97	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.94	5.93	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.89	9.89	10.91	11.92	12.94	13.96	14.98	16.00
1.00	1.96	2.93	3.90	4.88	5.86	6.85	7.85	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.81	7.81	8.82	9.84	10.86	11.88	12.91	13.94	14.97	16.00
1.00	1.94	2.88	3.83	4.80	5.78	6.77	7.77	8.78	9.80	10.83	11.86	12.89	13.93	14.96	16.00
1.00	1.92	2.84	3.78	4.74	5.72	6.71	7.72	8.73	9.76	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.89	2.79	3.71	4.66	5.64	6.64	7.65	8.68	9.71	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.84	2.71	3.62	4.56	5.54	6.55	7.57	8.61	9.66	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.77	2.60	3.48	4.42	5.41	6.44	7.48	8.54	9.60	10.67	11.73	12.80	13.87	14.93	16.00
1.00	1.66	2.42	3.28	4.24	5.26	6.31	7.38	8.46	9.54	10.62	11.70	12.78	13.85	14.93	16.00
1.00	1.45	2.14	3.00	3.99	5.06	6.16	7.27	8.38	9.48	10.58	11.67	12.75	13.84	14.92	16.00
1.00	1.00	1.68	2.58	3.67	4.83	6.00	7.16	8.30	9.42	10.54	11.64	12.74	13.83	14.91	16.00
1.00	1.00	1.00	1.97	3.29	4.60	5.86	7.07	8.24	9.38	10.51	11.62	12.72	13.82	14.91	16.00
1.00	1.00	1.00	1.00	2.90	4.42	5.76	7.01	8.20	9.36	10.49	11.61	12.71	13.81	14.91	16.00
1.00	1.00	1.00	1.00	2.90	4.42	5.76	7.01	8.20	9.36	10.49	11.61	12.71	13.81	14.91	16.00
1.00	1.00	1.00	1.97	3.29	4.60	5.86	7.07	8.24	9.38	10.51	11.62	12.72	13.82	14.91	16.00
1.00	1.00	1.68	2.58	3.67	4.83	6.00	7.16	8.30	9.42	10.54	11.64	12.74	13.83	14.91	16.00
1.00	1.45	2.14	3.00	3.99	5.06	6.16	7.27	8.38	9.48	10.58	11.67	12.75	13.84	14.92	16.00
1.00	1.66	2.42	3.28	4.24	5.26	6.31	7.38	8.46	9.54	10.62	11.70	12.78	13.85	14.93	16.00
1.00	1.77	2.60	3.48	4.42	5.41	6.44	7.48	8.54	9.60	10.67	11.73	12.80	13.87	14.93	16.00
1.00	1.84	2.71	3.62	4.56	5.54	6.55	7.57	8.61	9.66	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.89	2.79	3.71	4.66	5.64	6.64	7.65	8.68	9.71	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.92	2.84	3.78	4.74	5.72	6.71	7.72	8.73	9.76	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.94	2.88	3.83	4.80	5.78	6.77	7.77	8.78	9.80	10.83	11.86	12.89	13.93	14.96	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.81	7.81	8.82	9.84	10.86	11.88	12.91	13.94	14.97	16.00
1.00	1.96	2.93	3.90	4.88	5.86	6.85	7.85	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.89	9.89	10.91	11.92	12.94	13.96	14.98	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.98	2.97	3.95	4.94	5.93	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.98	3.98	4.97	5.97	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 2b (2)

Expanded view of spill through abutment B'/B = 0.8125 [scale 5:1]

	C					D					E					F					G
20	1.00	1.19	1.39	1.58	1.77	1.97	2.23	2.49	2.76	3.02	3.29	3.55	3.81	4.07	4.34	4.60	4.85	5.10	5.36	5.61	5.86
	1.00	1.15	1.32	1.51	1.71	1.92	2.17	2.42	2.69	2.95	3.22	3.49	3.76	4.03	4.29	4.56	4.82	5.07	5.33	5.59	5.84
	1.00	1.10	1.25	1.42	1.62	1.84	2.09	2.35	2.61	2.88	3.15	3.43	3.71	3.98	4.25	4.52	4.78	5.05	5.31	5.56	5.82
	1.00	1.00	1.14	1.31	1.51	1.74	2.00	2.26	2.54	2.81	3.09	3.37	3.66	3.94	4.21	4.49	4.75	5.02	5.28	5.54	5.80
	1.00	1.00	1.00	1.17	1.38	1.62	1.89	2.17	2.46	2.73	3.01	3.31	3.61	3.90	4.18	4.45	4.73	5.00	5.26	5.53	5.78
21	1.00	1.00	1.00	1.00	1.21	1.47	1.77	2.08	2.38	2.66	2.90	3.26	3.57	3.87	4.15	4.42	4.71	4.98	5.25	5.51	5.76
	1.00	1.00	1.00	1.00	1.00	1.28	1.64	2.00	2.33	2.64	2.93	3.24	3.55	3.85	4.14	4.42	4.70	4.97	5.24	5.50	5.76
	1.00	1.00	1.00	1.00	1.00	1.00	1.53	1.94	2.30	2.62	2.93	3.24	3.54	3.84	4.13	4.41	4.69	4.97	5.23	5.50	5.76
	1.00	1.00	1.00	1.00	1.00	1.00	1.53	1.94	2.30	2.62	2.93	3.24	3.54	3.84	4.13	4.41	4.69	4.97	5.23	5.50	5.76
	1.00	1.00	1.00	1.00	1.00	1.28	1.64	2.00	2.33	2.64	2.93	3.24	3.55	3.85	4.14	4.42	4.70	4.97	5.24	5.50	5.76
22	1.00	1.00	1.00	1.00	1.21	1.47	1.77	2.08	2.38	2.66	2.90	3.26	3.57	3.87	4.15	4.42	4.71	4.98	5.25	5.51	5.76
	1.00	1.00	1.00	1.17	1.38	1.62	1.89	2.17	2.46	2.73	3.01	3.31	3.61	3.90	4.18	4.45	4.73	5.00	5.26	5.53	5.78
	1.00	1.00	1.14	1.31	1.51	1.74	2.00	2.26	2.54	2.81	3.09	3.37	3.66	3.94	4.21	4.49	4.75	5.02	5.28	5.54	5.80
	1.00	1.10	1.25	1.42	1.62	1.84	2.09	2.35	2.61	2.88	3.15	3.43	3.71	3.98	4.25	4.52	4.78	5.05	5.31	5.56	5.82
	1.00	1.15	1.32	1.51	1.71	1.92	2.17	2.42	2.69	2.95	3.22	3.49	3.76	4.03	4.29	4.56	4.82	5.07	5.33	5.59	5.84
23	1.00	1.19	1.39	1.58	1.77	1.97	2.23	2.49	2.76	3.02	3.29	3.55	3.81	4.07	4.34	4.60	4.85	5.10	5.36	5.61	5.86

Figure 2c (1)

Global view of spill through abutment B'/B = 0.72

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.93	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.95	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.92	12.93	13.96	14.98	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.85	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.92	2.84	3.78	4.73	5.70	6.69	7.69	8.70	9.72	10.76	11.80	12.85	13.89	14.95	16.00
1.00	1.89	2.80	3.72	4.66	5.62	6.61	7.61	8.63	9.66	10.71	11.76	12.81	13.87	14.94	16.00
1.00	1.86	2.73	3.63	4.56	5.52	6.51	7.52	8.55	9.59	10.65	11.71	12.78	13.85	14.93	16.00
1.00	1.81	2.65	3.52	4.44	5.39	6.39	7.41	8.45	9.51	10.58	11.66	12.74	13.83	14.91	16.00
1.00	1.74	2.52	3.36	4.27	5.23	6.24	7.28	8.34	9.42	10.51	11.60	12.70	13.80	14.90	16.00
1.00	1.62	2.33	3.14	4.04	5.02	6.05	7.12	8.21	9.32	10.43	11.54	12.66	13.77	14.89	16.00
1.00	1.42	2.05	2.83	3.74	4.75	5.83	6.94	8.07	9.21	10.35	11.48	12.62	13.75	14.87	16.00
1.00	1.00	1.61	2.40	3.35	4.42	5.57	6.75	7.93	9.10	10.27	11.43	12.58	13.72	14.86	16.00
1.00	1.00	1.00	1.80	2.82	4.02	5.28	6.55	7.79	9.00	10.20	11.38	12.54	13.70	14.85	16.00
1.00	1.00	1.00	1.00	2.09	3.56	5.00	6.37	7.67	8.92	10.14	11.34	12.52	13.68	14.84	16.00
1.00	1.00	1.00	1.00	1.00	3.11	4.79	6.25	7.60	8.88	10.11	11.32	12.50	13.68	14.84	16.00
1.00	1.00	1.00	1.00	1.00	3.11	4.79	6.25	7.60	8.88	10.11	11.32	12.50	13.68	14.84	16.00
1.00	1.00	1.00	1.00	2.09	3.56	5.00	6.37	7.67	8.92	10.14	11.34	12.52	13.68	14.84	16.00
1.00	1.00	1.00	1.80	2.82	4.02	5.28	6.55	7.79	9.00	10.20	11.38	12.54	13.70	14.85	16.00
1.00	1.00	1.61	2.40	3.35	4.42	5.57	6.75	7.93	9.10	10.27	11.43	12.58	13.72	14.86	16.00
1.00	1.42	2.05	2.83	3.74	4.75	5.83	6.94	8.07	9.21	10.35	11.48	12.62	13.75	14.87	16.00
1.00	1.62	2.33	3.14	4.04	5.02	6.05	7.12	8.21	9.32	10.43	11.54	12.66	13.77	14.89	16.00
1.00	1.74	2.52	3.36	4.27	5.23	6.24	7.28	8.34	9.42	10.51	11.60	12.70	13.80	14.90	16.00
1.00	1.81	2.65	3.52	4.44	5.39	6.39	7.41	8.45	9.51	10.58	11.66	12.74	13.83	14.91	16.00
1.00	1.86	2.73	3.63	4.56	5.52	6.51	7.52	8.55	9.59	10.65	11.71	12.78	13.85	14.93	16.00
1.00	1.89	2.80	3.72	4.66	5.62	6.61	7.61	8.63	9.66	10.71	11.76	12.81	13.87	14.94	16.00
1.00	1.92	2.84	3.78	4.73	5.70	6.69	7.69	8.70	9.72	10.76	11.80	12.85	13.89	14.95	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.85	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.97	2.95	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.92	12.93	13.96	14.98	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.93	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.98	14.99	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Expanded view of spill through abutment B'/B = 0.72 [scale 5:1]

	D					E					F					G					H
20	1.00	1.22	1.44	1.66	1.87	2.09	2.39	2.68	2.97	3.26	3.56	3.84	4.13	4.42	4.71	5.00	5.27	5.55	5.82	6.09	6.37
	1.00	1.17	1.37	1.57	1.80	2.04	2.31	2.60	2.89	3.18	3.48	3.78	4.07	4.37	4.66	4.95	5.23	5.51	5.79	6.07	6.34
	1.00	1.11	1.28	1.48	1.70	1.95	2.22	2.51	2.80	3.10	3.40	3.71	4.01	4.31	4.61	4.90	5.19	5.48	5.76	6.04	6.32
	1.00	1.00	1.16	1.35	1.58	1.83	2.12	2.41	2.71	3.02	3.32	3.64	3.95	4.26	4.56	4.86	5.16	5.45	5.73	6.02	6.30
	1.00	1.00	1.00	1.19	1.43	1.70	2.00	2.31	2.62	2.93	3.23	3.57	3.90	4.22	4.52	4.83	5.13	5.42	5.71	5.99	6.27
21	1.00	1.00	1.00	1.00	1.24	1.53	1.86	2.21	2.54	2.85	3.11	3.51	3.85	4.18	4.49	4.79	5.10	5.40	5.69	5.98	6.25
	1.00	1.00	1.00	1.00	1.00	1.31	1.72	2.11	2.48	2.82	3.14	3.49	3.83	4.16	4.48	4.78	5.09	5.39	5.68	5.97	6.25
	1.00	1.00	1.00	1.00	1.00	1.00	1.59	2.05	2.44	2.80	3.14	3.49	3.82	4.15	4.47	4.78	5.08	5.38	5.68	5.97	6.25
	1.00	1.00	1.00	1.00	1.00	1.00	1.59	2.05	2.44	2.80	3.14	3.49	3.82	4.15	4.47	4.78	5.08	5.38	5.68	5.97	6.25
	1.00	1.00	1.00	1.00	1.00	1.31	1.72	2.11	2.48	2.82	3.14	3.49	3.83	4.16	4.48	4.78	5.09	5.39	5.68	5.97	6.25
22	1.00	1.00	1.00	1.00	1.24	1.53	1.86	2.21	2.54	2.85	3.11	3.51	3.85	4.18	4.49	4.79	5.10	5.40	5.69	5.98	6.25
	1.00	1.00	1.00	1.19	1.43	1.70	2.00	2.31	2.62	2.93	3.23	3.57	3.90	4.22	4.52	4.83	5.13	5.42	5.71	5.99	6.27
	1.00	1.00	1.16	1.35	1.58	1.83	2.12	2.41	2.71	3.02	3.32	3.64	3.95	4.26	4.56	4.86	5.16	5.45	5.73	6.02	6.30
	1.00	1.11	1.28	1.48	1.70	1.95	2.22	2.51	2.80	3.10	3.40	3.71	4.01	4.31	4.61	4.90	5.19	5.48	5.76	6.04	6.32
	1.00	1.17	1.37	1.57	1.80	2.04	2.31	2.60	2.89	3.18	3.48	3.78	4.07	4.37	4.66	4.95	5.23	5.51	5.79	6.07	6.34
23	1.00	1.22	1.44	1.66	1.87	2.09	2.39	2.68	2.97	3.26	3.56	3.84	4.13	4.42	4.71	5.00	5.27	5.55	5.82	6.09	6.37

Figure 2d (1)

Global view of spill through abutment B'/B = 0.625

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.96	2.91	3.88	4.85	5.82	6.81	7.80	8.81	9.82	10.84	11.86	12.89	13.93	14.96	16.00
1.00	1.94	2.88	3.83	4.79	5.76	6.75	7.74	8.74	9.76	10.79	11.82	12.86	13.90	14.95	16.00
1.00	1.92	2.85	3.78	4.73	5.69	6.67	7.66	8.67	9.69	10.73	11.77	12.82	13.88	14.94	16.00
1.00	1.90	2.80	3.72	4.65	5.61	6.58	7.57	8.58	9.61	10.65	11.71	12.77	13.85	14.92	16.00
1.00	1.87	2.74	3.64	4.56	5.50	6.47	7.46	8.48	9.52	10.57	11.64	12.72	13.81	14.90	16.00
1.00	1.83	2.67	3.54	4.43	5.37	6.33	7.33	8.36	9.41	10.48	11.56	12.66	13.77	14.88	16.00
1.00	1.77	2.57	3.40	4.28	5.20	6.16	7.17	8.21	9.27	10.36	11.47	12.59	13.72	14.86	16.00
1.00	1.70	2.43	3.23	4.08	4.99	5.96	6.97	8.03	9.12	10.23	11.37	12.52	13.67	14.83	16.00
1.00	1.58	2.24	2.99	3.82	4.73	5.70	6.74	7.82	8.94	10.08	11.25	12.43	13.61	14.81	16.00
1.00	1.39	1.96	2.67	3.48	4.39	5.39	6.45	7.57	8.73	9.91	11.12	12.33	13.55	14.78	16.00
1.00	1.00	1.55	2.24	3.05	3.98	5.00	6.11	7.28	8.49	9.73	10.98	12.23	13.49	14.74	16.00
1.00	1.00	1.00	1.69	2.51	3.46	4.53	5.71	6.95	8.23	9.53	10.83	12.13	13.42	14.71	16.00
1.00	1.00	1.00	1.00	1.83	2.82	3.96	5.24	6.59	7.96	9.33	10.68	12.03	13.36	14.68	16.00
1.00	1.00	1.00	1.00	1.00	2.02	3.26	4.70	6.20	7.69	9.14	10.55	11.94	13.30	14.66	16.00
1.00	1.00	1.00	1.00	1.00	1.00	2.34	4.11	5.83	7.45	8.98	10.45	11.87	13.26	14.64	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.56	5.56	7.30	8.89	10.39	11.84	13.24	14.63	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.56	5.56	7.30	8.89	10.39	11.84	13.24	14.63	16.00
1.00	1.00	1.00	1.00	1.00	1.00	2.34	4.11	5.83	7.45	8.98	10.45	11.87	13.26	14.64	16.00
1.00	1.00	1.00	1.00	1.00	2.02	3.26	4.70	6.20	7.69	9.14	10.55	11.94	13.30	14.66	16.00
1.00	1.00	1.00	1.00	1.83	2.82	3.96	5.24	6.59	7.96	9.33	10.68	12.03	13.36	14.68	16.00
1.00	1.00	1.00	1.69	2.51	3.46	4.53	5.71	6.95	8.23	9.53	10.83	12.13	13.42	14.71	16.00
1.00	1.00	1.55	2.24	3.05	3.98	5.00	6.11	7.28	8.49	9.73	10.98	12.23	13.49	14.74	16.00
1.00	1.39	1.96	2.67	3.48	4.39	5.39	6.45	7.57	8.73	9.91	11.12	12.33	13.55	14.78	16.00
1.00	1.58	2.24	2.99	3.82	4.73	5.70	6.74	7.82	8.94	10.08	11.25	12.43	13.61	14.81	16.00
1.00	1.70	2.43	3.23	4.08	4.99	5.96	6.97	8.03	9.12	10.23	11.37	12.52	13.67	14.83	16.00
1.00	1.77	2.57	3.40	4.28	5.20	6.16	7.17	8.21	9.27	10.36	11.47	12.59	13.72	14.86	16.00
1.00	1.83	2.67	3.54	4.43	5.37	6.33	7.33	8.36	9.41	10.48	11.56	12.66	13.77	14.88	16.00
1.00	1.87	2.74	3.64	4.56	5.50	6.47	7.46	8.48	9.52	10.57	11.64	12.72	13.81	14.90	16.00
1.00	1.90	2.80	3.72	4.65	5.61	6.58	7.57	8.58	9.61	10.65	11.71	12.77	13.85	14.92	16.00
1.00	1.92	2.85	3.78	4.73	5.69	6.67	7.66	8.67	9.69	10.73	11.77	12.82	13.88	14.94	16.00
1.00	1.94	2.88	3.83	4.79	5.76	6.75	7.74	8.74	9.76	10.79	11.82	12.86	13.90	14.95	16.00
1.00	1.96	2.91	3.88	4.85	5.82	6.81	7.80	8.81	9.82	10.84	11.86	12.89	13.93	14.96	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.92	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 2d (2)

Expanded view of spill through abutment B'/B = 0.625 [scale 5:1]

	F					G					H					I					J
20	1.00	1.27	1.54	1.80	2.07	2.34	2.69	3.05	3.40	3.75	4.11	4.45	4.80	5.14	5.49	5.83	6.16	6.48	6.80	7.13	7.45
	1.00	1.21	1.45	1.70	1.97	2.27	2.60	2.94	3.30	3.65	4.01	4.36	4.72	5.07	5.42	5.77	6.10	6.43	6.76	7.09	7.42
	1.00	1.14	1.34	1.58	1.85	2.16	2.49	2.83	3.19	3.55	3.91	4.28	4.64	5.00	5.36	5.71	6.05	6.39	6.73	7.06	7.39
	1.00	1.00	1.19	1.43	1.70	2.02	2.36	2.71	3.08	3.45	3.81	4.19	4.57	4.94	5.30	5.66	6.01	6.35	6.69	7.03	7.36
	1.00	1.00	1.00	1.24	1.52	1.85	2.21	2.59	2.97	3.34	3.70	4.11	4.50	4.88	5.25	5.61	5.97	6.32	6.66	7.00	7.33
21	1.00	1.00	1.00	1.00	1.29	1.64	2.04	2.46	2.86	3.24	3.56	4.03	4.45	4.84	5.21	5.56	5.94	6.29	6.64	6.98	7.30
	1.00	1.00	1.00	1.00	1.00	1.38	1.87	2.35	2.79	3.20	3.59	4.01	4.42	4.81	5.19	5.56	5.92	6.28	6.63	6.97	7.30
	1.00	1.00	1.00	1.00	1.00	1.00	1.71	2.27	2.75	3.18	3.59	4.00	4.41	4.80	5.18	5.55	5.91	6.27	6.62	6.96	7.30
	1.00	1.00	1.00	1.00	1.00	1.00	1.71	2.27	2.75	3.18	3.59	4.00	4.41	4.80	5.18	5.55	5.91	6.27	6.62	6.96	7.30
	1.00	1.00	1.00	1.00	1.00	1.38	1.87	2.35	2.79	3.20	3.59	4.01	4.42	4.81	5.19	5.56	5.92	6.28	6.63	6.97	7.30
22	1.00	1.00	1.00	1.00	1.29	1.64	2.04	2.46	2.86	3.24	3.56	4.03	4.45	4.84	5.21	5.56	5.94	6.29	6.64	6.98	7.30
	1.00	1.00	1.00	1.24	1.52	1.85	2.21	2.59	2.97	3.34	3.70	4.11	4.50	4.88	5.25	5.61	5.97	6.32	6.66	7.00	7.33
	1.00	1.00	1.19	1.43	1.70	2.02	2.36	2.71	3.08	3.45	3.81	4.19	4.57	4.94	5.30	5.66	6.01	6.35	6.69	7.03	7.36
	1.00	1.14	1.34	1.58	1.85	2.16	2.49	2.83	3.19	3.55	3.91	4.28	4.64	5.00	5.36	5.71	6.05	6.39	6.73	7.06	7.39
	1.00	1.21	1.45	1.70	1.97	2.27	2.60	2.94	3.30	3.65	4.01	4.36	4.72	5.07	5.42	5.77	6.10	6.43	6.76	7.09	7.42
23	1.00	1.27	1.54	1.80	2.07	2.34	2.69	3.05	3.40	3.75	4.11	4.45	4.80	5.14	5.49	5.83	6.16	6.48	6.80	7.13	7.45

Figure 3a (1)

Global view of guidebank abutment B'/B = 0.91

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 3d (2)

Expanded view of guidebank abutment B'/B = 0.91 [scale 4:1]

	A				B				C				D				E
19	1.00	1.20	1.41	1.61	1.82	2.05	2.29	2.53	2.76	3.01	3.26	3.52	3.77	4.02	4.28	4.54	4.79
	1.00	1.18	1.37	1.57	1.78	2.01	2.25	2.49	2.73	2.98	3.23	3.49	3.75	4.00	4.26	4.52	4.77
	1.00	1.15	1.33	1.52	1.73	1.96	2.20	2.44	2.69	2.95	3.20	3.46	3.72	3.98	4.24	4.50	4.76
	1.00	1.10	1.26	1.45	1.67	1.90	2.14	2.39	2.65	2.91	3.17	3.44	3.70	3.96	4.23	4.49	4.75
20	1.00	1.00	1.15	1.35	1.61	1.82	2.07	2.33	2.61	2.87	3.14	3.41	3.68	3.94	4.21	4.47	4.74
	1.00	1.00	1.00	1.20	1.44	1.70	1.98	2.26	2.55	2.83	3.10	3.38	3.65	3.92	4.19	4.46	4.73
	1.00	1.00	1.00	1.00	1.25	1.57	1.89	2.19	2.49	2.78	3.07	3.35	3.63	3.91	4.18	4.45	4.72
	1.00	1.00	1.00	1.00	1.00	1.44	1.80	2.13	2.44	2.75	3.04	3.33	3.61	3.89	4.17	4.44	4.71
21	1.00	1.00	1.00	1.00	1.00	1.39	1.75	2.09	2.40	2.72	3.02	3.31	3.59	3.88	4.16	4.43	4.70
	1.00	1.00	1.00	1.00	1.00	1.37	1.73	2.07	2.39	2.70	3.01	3.30	3.59	3.87	4.15	4.43	4.70
	1.00	1.00	1.00	1.00	1.00	1.37	1.73	2.07	2.39	2.70	3.00	3.30	3.59	3.87	4.15	4.43	4.70
	1.00	1.00	1.00	1.00	1.00	1.39	1.74	2.08	2.39	2.71	3.01	3.30	3.59	3.87	4.15	4.43	4.70
22	1.00	1.00	1.00	1.00	1.00	1.43	1.78	2.11	2.40	2.72	3.02	3.31	3.59	3.88	4.16	4.43	4.70
	1.00	1.00	1.00	1.00	1.24	1.55	1.86	2.16	2.46	2.75	3.05	3.33	3.61	3.89	4.17	4.44	4.71
	1.00	1.00	1.00	1.18	1.40	1.66	1.94	2.23	2.51	2.79	3.08	3.36	3.63	3.91	4.18	4.45	4.72
	1.00	1.00	1.14	1.31	1.52	1.76	2.02	2.29	2.56	2.84	3.11	3.38	3.65	3.92	4.19	4.46	4.73
23	1.00	1.09	1.24	1.41	1.61	1.84	2.09	2.35	2.61	2.88	3.14	3.41	3.68	3.94	4.21	4.48	4.74
	1.00	1.14	1.30	1.49	1.69	1.91	2.15	2.40	2.66	2.91	3.18	3.44	3.70	3.96	4.23	4.49	4.75
	1.00	1.17	1.35	1.54	1.75	1.97	2.21	2.45	2.70	2.95	3.21	3.46	3.72	3.98	4.24	4.50	4.76
	1.00	1.19	1.38	1.58	1.79	2.02	2.25	2.49	2.73	2.98	3.24	3.49	3.75	4.00	4.26	4.52	4.77
24	1.00	1.20	1.41	1.61	1.82	2.05	2.29	2.53	2.76	3.01	3.26	3.52	3.77	4.02	4.28	4.54	4.79

Figure 3b (1)

Global view of guidebank abutment B'/B = 0.8125

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.98	7.98	8.98	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.94	5.94	6.93	7.93	8.93	9.94	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.96	3.94	4.92	5.91	6.91	7.91	8.91	9.91	10.92	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.92	12.94	13.96	14.98	16.00
1.00	1.96	2.93	3.90	4.87	5.85	6.85	7.84	8.85	9.86	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.95	2.90	3.86	4.83	5.81	6.81	7.81	8.81	9.83	10.85	11.88	12.90	13.93	14.97	16.00
1.00	1.93	2.87	3.82	4.79	5.76	6.75	7.76	8.77	9.79	10.82	11.85	12.88	13.92	14.96	16.00
1.00	1.91	2.83	3.77	4.73	5.70	6.69	7.70	8.72	9.75	10.78	11.82	12.86	13.91	14.95	16.00
1.00	1.88	2.78	3.70	4.65	5.62	6.62	7.63	8.66	9.69	10.74	11.79	12.84	13.89	14.94	16.00
1.00	1.84	2.70	3.60	4.54	5.52	6.52	7.55	8.59	9.63	10.69	11.75	12.81	13.87	14.94	16.00
1.00	1.77	2.58	3.46	4.40	5.38	6.40	7.45	8.50	9.57	10.64	11.71	12.78	13.86	14.93	16.00
1.00	1.66	2.41	3.26	4.21	5.22	6.27	7.34	8.42	9.50	10.59	11.67	12.76	13.84	14.92	16.00
1.00	1.44	2.12	2.97	3.95	5.01	6.11	7.21	8.32	9.43	10.53	11.63	12.73	13.82	14.91	16.00
1.00	1.00	1.67	2.55	3.62	4.77	5.93	7.09	8.23	9.37	10.49	11.60	12.71	13.81	14.90	16.00
1.00	1.00	1.00	1.94	3.22	4.51	5.76	6.98	8.15	9.31	10.45	11.57	12.69	13.79	14.90	16.00
1.00	1.00	1.00	1.00	2.81	4.29	5.64	6.89	8.10	9.27	10.42	11.55	12.67	13.79	14.89	16.00
1.00	1.00	1.00	1.00	2.71	4.22	5.59	6.86	8.08	9.26	10.41	11.55	12.67	13.78	14.89	16.00
1.00	1.00	1.00	1.00	2.81	4.29	5.63	6.89	8.10	9.27	10.42	11.55	12.67	13.79	14.89	16.00
1.00	1.00	1.00	1.94	3.22	4.51	5.76	6.98	8.15	9.31	10.45	11.57	12.69	13.79	14.90	16.00
1.00	1.00	1.67	2.55	3.62	4.77	5.93	7.09	8.23	9.37	10.49	11.60	12.70	13.81	14.90	16.00
1.00	1.44	2.12	2.97	3.95	5.01	6.11	7.21	8.32	9.43	10.53	11.63	12.73	13.82	14.91	16.00
1.00	1.65	2.41	3.26	4.21	5.22	6.27	7.34	8.42	9.50	10.59	11.67	12.75	13.84	14.92	16.00
1.00	1.77	2.58	3.46	4.40	5.38	6.40	7.45	8.50	9.57	10.64	11.71	12.78	13.86	14.93	16.00
1.00	1.84	2.70	3.60	4.54	5.52	6.52	7.54	8.58	9.63	10.69	11.75	12.81	13.87	14.94	16.00
1.00	1.88	2.78	3.70	4.65	5.62	6.61	7.63	8.66	9.69	10.74	11.78	12.84	13.89	14.94	16.00
1.00	1.91	2.83	3.77	4.73	5.70	6.69	7.70	8.72	9.74	10.78	11.82	12.86	13.91	14.95	16.00
1.00	1.93	2.87	3.82	4.79	5.76	6.75	7.76	8.77	9.79	10.82	11.85	12.88	13.92	14.96	16.00
1.00	1.95	2.90	3.86	4.83	5.81	6.80	7.80	8.81	9.83	10.85	11.87	12.90	13.93	14.97	16.00
1.00	1.96	2.92	3.89	4.87	5.85	6.84	7.84	8.85	9.86	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.88	7.87	8.88	9.89	10.90	11.92	12.93	13.96	14.98	16.00
1.00	1.98	2.96	3.94	4.92	5.91	6.90	7.90	8.90	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.98	2.97	3.95	4.94	5.93	6.93	7.92	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.95	6.94	7.94	8.94	9.95	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.97	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.97	7.97	8.97	9.98	10.98	11.98	12.99	13.99	14.99	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 3b (2)

Expanded view of guidebank abutment B'/B = 0.8125 [scale 4:1]

	C				D				E				F				G
18	1.67	1.89	2.11	2.33	2.55	2.82	3.09	3.36	3.62	3.91	4.20	4.48	4.77	5.06	5.35	5.64	5.93
	1.50	1.73	1.95	2.19	2.43	2.70	2.97	3.25	3.53	3.82	4.12	4.41	4.71	5.00	5.30	5.59	5.89
	1.33	1.56	1.79	2.03	2.29	2.56	2.85	3.14	3.43	3.73	4.04	4.34	4.64	4.94	5.25	5.55	5.85
	1.17	1.39	1.62	1.87	2.13	2.42	2.71	3.02	3.33	3.64	3.95	4.27	4.58	4.89	5.19	5.50	5.81
19	1.00	1.21	1.44	1.68	1.94	2.26	2.58	2.90	3.22	3.55	3.87	4.19	4.51	4.83	5.14	5.46	5.76
	1.00	1.00	1.23	1.49	1.78	2.10	2.44	2.78	3.12	3.46	3.79	4.12	4.45	4.78	5.10	5.42	5.73
	1.00	1.00	1.00	1.27	1.57	1.93	2.29	2.65	3.01	3.37	3.72	4.06	4.40	4.73	5.06	5.38	5.70
	1.00	1.00	1.00	1.00	1.33	1.74	2.15	2.54	2.91	3.28	3.65	4.00	4.34	4.68	5.02	5.35	5.67
20	1.00	1.00	1.00	1.00	1.00	1.57	2.02	2.43	2.81	3.21	3.59	3.95	4.29	4.64	4.98	5.32	5.64
	1.00	1.00	1.00	1.00	1.00	1.49	1.95	2.37	2.77	3.16	3.54	3.91	4.27	4.62	4.96	5.30	5.63
	1.00	1.00	1.00	1.00	1.00	1.46	1.91	2.33	2.74	3.13	3.51	3.88	4.24	4.60	4.94	5.28	5.62
	1.00	1.00	1.00	1.00	1.00	1.45	1.89	2.31	2.72	3.11	3.50	3.87	4.23	4.58	4.93	5.27	5.61
21	1.00	1.00	1.00	1.00	1.00	1.44	1.88	2.30	2.71	3.11	3.49	3.86	4.22	4.58	4.93	5.26	5.59
	1.00	1.00	1.00	1.00	1.00	1.45	1.89	2.31	2.72	3.11	3.50	3.87	4.23	4.58	4.93	5.27	5.60
	1.00	1.00	1.00	1.00	1.00	1.46	1.91	2.33	2.74	3.13	3.51	3.88	4.24	4.60	4.94	5.28	5.61
	1.00	1.00	1.00	1.00	1.00	1.49	1.95	2.37	2.77	3.16	3.54	3.91	4.27	4.62	4.96	5.29	5.62
22	1.00	1.00	1.00	1.00	1.00	1.57	2.02	2.43	2.81	3.21	3.59	3.95	4.29	4.64	4.98	5.31	5.63
	1.00	1.00	1.00	1.00	1.33	1.74	2.15	2.54	2.91	3.28	3.65	4.00	4.34	4.68	5.02	5.34	5.67
	1.00	1.00	1.00	1.27	1.57	1.93	2.29	2.65	3.01	3.37	3.72	4.06	4.39	4.73	5.06	5.38	5.70
	1.00	1.00	1.23	1.49	1.78	2.10	2.44	2.78	3.12	3.45	3.79	4.12	4.45	4.78	5.10	5.42	5.73
23	1.00	1.21	1.44	1.68	1.94	2.26	2.58	2.90	3.22	3.55	3.87	4.19	4.51	4.83	5.15	5.46	5.76
	1.17	1.39	1.62	1.87	2.13	2.42	2.71	3.02	3.33	3.64	3.95	4.26	4.58	4.89	5.20	5.50	5.81
	1.33	1.56	1.79	2.03	2.29	2.56	2.85	3.14	3.43	3.73	4.04	4.34	4.64	4.94	5.25	5.55	5.85
	1.50	1.73	1.95	2.19	2.43	2.70	2.97	3.25	3.53	3.82	4.12	4.41	4.71	5.00	5.30	5.59	5.89
24	1.67	1.89	2.11	2.33	2.55	2.82	3.09	3.36	3.62	3.91	4.20	4.48	4.77	5.06	5.35	5.64	5.93

Figure 3c (1)

Global view of guidebank abutment B'/B = 0.72

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.97	7.97	8.97	9.98	10.98	11.98	12.99	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.96	3.95	4.93	5.92	6.92	7.92	8.92	9.92	10.93	11.94	12.95	13.97	14.98	16.00
1.00	1.97	2.95	3.93	4.91	5.89	6.89	7.88	8.89	9.89	10.90	11.92	12.94	13.96	14.98	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.85	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.95	2.91	3.87	4.84	5.81	6.80	7.80	8.80	9.82	10.84	11.86	12.89	13.93	14.96	16.00
1.00	1.94	2.88	3.83	4.79	5.76	6.75	7.74	8.75	9.77	10.80	11.83	12.87	13.91	14.95	16.00
1.00	1.92	2.84	3.78	4.73	5.70	6.68	7.68	8.69	9.72	10.75	11.79	12.84	13.89	14.94	16.00
1.00	1.89	2.79	3.71	4.65	5.61	6.60	7.60	8.62	9.65	10.70	11.75	12.81	13.87	14.93	16.00
1.00	1.86	2.73	3.63	4.55	5.51	6.49	7.50	8.53	9.58	10.63	11.70	12.77	13.84	14.92	16.00
1.00	1.81	2.64	3.51	4.42	5.38	6.37	7.39	8.43	9.49	10.56	11.64	12.73	13.82	14.91	16.00
1.00	1.73	2.51	3.35	4.25	5.21	6.21	7.25	8.31	9.39	10.48	11.58	12.68	13.79	14.89	16.00
1.00	1.62	2.33	3.13	4.02	4.99	6.02	7.08	8.18	9.28	10.40	11.52	12.64	13.76	14.88	16.00
1.00	1.41	2.04	2.82	3.72	4.72	5.79	6.89	8.02	9.16	10.31	11.45	12.59	13.73	14.86	16.00
1.00	1.00	1.61	2.38	3.32	4.38	5.51	6.68	7.86	9.04	10.22	11.38	12.54	13.70	14.85	16.00
1.00	1.00	1.00	1.79	2.78	3.96	5.21	6.46	7.70	8.93	10.13	11.32	12.50	13.67	14.84	16.00
1.00	1.00	1.00	1.00	2.07	3.48	4.90	6.26	7.56	8.83	10.06	11.27	12.47	13.65	14.83	16.00
1.00	1.00	1.00	1.00	1.00	3.00	4.64	6.10	7.46	8.76	10.02	11.24	12.45	13.64	14.82	16.00
1.00	1.00	1.00	1.00	1.00	2.89	4.55	6.05	7.43	8.74	10.00	11.23	12.44	13.63	14.82	16.00
1.00	1.00	1.00	1.00	1.00	3.00	4.64	6.10	7.46	8.76	10.02	11.24	12.45	13.64	14.82	16.00
1.00	1.00	1.00	1.00	2.07	3.48	4.90	6.26	7.56	8.83	10.06	11.27	12.47	13.65	14.83	16.00
1.00	1.00	1.00	1.79	2.78	3.96	5.21	6.46	7.70	8.93	10.13	11.32	12.50	13.67	14.84	16.00
1.00	1.00	1.61	2.38	3.32	4.38	5.51	6.68	7.86	9.04	10.21	11.38	12.54	13.70	14.85	16.00
1.00	1.41	2.04	2.82	3.72	4.72	5.79	6.89	8.02	9.16	10.30	11.45	12.59	13.73	14.86	16.00
1.00	1.62	2.32	3.13	4.02	4.99	6.02	7.08	8.17	9.28	10.40	11.51	12.64	13.76	14.88	16.00
1.00	1.73	2.51	3.35	4.25	5.21	6.21	7.25	8.31	9.39	10.48	11.58	12.68	13.79	14.89	16.00
1.00	1.81	2.64	3.51	4.42	5.37	6.36	7.38	8.43	9.49	10.56	11.64	12.73	13.82	14.91	16.00
1.00	1.86	2.73	3.62	4.55	5.51	6.49	7.50	8.53	9.57	10.63	11.70	12.77	13.84	14.92	16.00
1.00	1.89	2.79	3.71	4.65	5.61	6.59	7.60	8.62	9.65	10.69	11.75	12.80	13.87	14.93	16.00
1.00	1.92	2.84	3.78	4.72	5.69	6.68	7.67	8.69	9.71	10.75	11.79	12.84	13.89	14.94	16.00
1.00	1.94	2.88	3.82	4.78	5.76	6.74	7.74	8.75	9.77	10.79	11.83	12.87	13.91	14.95	16.00
1.00	1.95	2.90	3.86	4.83	5.81	6.80	7.79	8.80	9.81	10.83	11.86	12.89	13.93	14.96	16.00
1.00	1.96	2.93	3.89	4.87	5.85	6.84	7.84	8.84	9.85	10.87	11.89	12.91	13.94	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.87	8.88	9.88	10.90	11.91	12.93	13.95	14.98	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.90	8.91	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.98	2.97	3.96	4.95	5.94	6.93	7.93	8.93	9.94	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Expanded view of guidebank abutment B'/B = 0.72 [scale 4:1]

	C				D				E				F				G				H
18	1.00	1.00	1.20	1.40	1.79	2.04	2.29	2.54	2.78	3.08	3.37	3.67	3.96	4.28	4.59	4.90	5.21	5.52	5.84	6.15	6.46
	1.00	1.00	1.00	1.23	1.52	1.79	2.06	2.33	2.62	2.92	3.22	3.53	3.85	4.17	4.49	4.81	5.13	5.45	5.77	6.09	6.40
	1.00	1.00	1.00	1.00	1.26	1.54	1.82	2.12	2.43	2.74	3.07	3.39	3.72	4.06	4.39	4.72	5.05	5.38	5.70	6.03	6.35
	1.00	1.00	1.00	1.00	1.00	1.28	1.58	1.90	2.24	2.57	2.90	3.25	3.60	3.94	4.29	4.63	4.97	5.31	5.64	5.97	6.30
19	1.00	1.00	1.00	1.00	1.00	1.00	1.31	1.66	2.07	2.37	2.73	3.10	3.48	3.83	4.19	4.54	4.90	5.24	5.58	5.92	6.26
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.35	1.74	2.14	2.54	2.94	3.34	3.72	4.09	4.46	4.82	5.18	5.53	5.87	6.21
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.41	1.89	2.35	2.79	3.21	3.61	4.00	4.38	4.75	5.12	5.48	5.83	6.18
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.66	2.19	2.66	3.10	3.52	3.92	4.31	4.69	5.07	5.43	5.79	6.14
20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.57	2.09	2.56	3.00	3.44	3.86	4.25	4.64	5.02	5.39	5.75	6.10
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.52	2.03	2.50	2.95	3.39	3.81	4.21	4.60	4.99	5.36	5.73	6.09
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.50	1.99	2.46	2.91	3.35	3.77	4.18	4.58	4.96	5.34	5.71	6.07
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.49	1.97	2.44	2.89	3.33	3.75	4.16	4.56	4.95	5.33	5.70	6.06
21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.49	1.97	2.44	2.89	3.33	3.75	4.16	4.55	4.94	5.32	5.69	6.05
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.49	1.98	2.45	2.90	3.33	3.76	4.16	4.56	4.95	5.33	5.70	6.06
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.51	2.00	2.47	2.92	3.36	3.78	4.18	4.58	4.96	5.34	5.71	6.07
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.55	2.05	2.52	2.96	3.39	3.81	4.21	4.60	4.99	5.36	5.73	6.09
22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.63	2.14	2.59	3.00	3.45	3.86	4.26	4.64	5.02	5.39	5.75	6.10
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.37	1.83	2.28	2.71	3.12	3.53	3.93	4.32	4.69	5.07	5.43	5.79	6.14
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.30	1.65	2.04	2.44	2.84	3.24	3.63	4.01	4.39	4.76	5.12	5.48	5.83	6.18
	1.00	1.00	1.00	1.00	1.00	1.00	1.26	1.55	1.88	2.23	2.61	2.98	3.36	3.73	4.10	4.46	4.82	5.18	5.53	5.87	6.21
23	1.00	1.00	1.00	1.00	1.00	1.24	1.50	1.78	2.07	2.42	2.77	3.13	3.48	3.84	4.19	4.55	4.90	5.24	5.58	5.92	6.26
	1.00	1.00	1.00	1.00	1.22	1.46	1.72	1.99	2.28	2.60	2.93	3.27	3.61	3.95	4.29	4.63	4.97	5.31	5.64	5.97	6.30
	1.00	1.00	1.00	1.21	1.43	1.67	1.92	2.19	2.47	2.77	3.09	3.41	3.73	4.06	4.39	4.72	5.05	5.38	5.70	6.03	6.35
	1.00	1.00	1.20	1.41	1.62	1.86	2.11	2.37	2.64	2.93	3.23	3.54	3.85	4.17	4.49	4.81	5.13	5.45	5.77	6.09	6.40
24	1.00	1.20	1.40	1.59	1.79	2.04	2.29	2.54	2.78	3.08	3.37	3.67	3.96	4.27	4.59	4.90	5.21	5.52	5.84	6.15	6.46

Figure 3d (1)

Global view of guidebank abutment B'/B = 0.625

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.98	2.97	3.96	4.95	5.94	6.93	7.93	8.93	9.94	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.95	2.90	3.86	4.83	5.80	6.79	7.78	8.79	9.80	10.82	11.85	12.88	13.92	14.96	16.00
1.00	1.93	2.86	3.80	4.75	5.72	6.70	7.69	8.70	9.72	10.75	11.79	12.84	13.89	14.94	16.00
1.00	1.90	2.81	3.73	4.67	5.63	6.60	7.59	8.60	9.63	10.67	11.72	12.78	13.85	14.93	16.00
1.00	1.87	2.75	3.65	4.57	5.51	6.48	7.47	8.49	9.53	10.58	11.65	12.73	13.81	14.91	16.00
1.00	1.83	2.67	3.54	4.44	5.37	6.34	7.33	8.36	9.41	10.48	11.56	12.66	13.77	14.88	16.00
1.00	1.77	2.57	3.40	4.28	5.20	6.16	7.16	8.20	9.26	10.35	11.46	12.59	13.72	14.86	16.00
1.00	1.70	2.43	3.22	4.07	4.98	5.95	6.96	8.01	9.10	10.21	11.35	12.50	13.66	14.83	16.00
1.00	1.58	2.24	2.98	3.81	4.71	5.68	6.71	7.79	8.91	10.05	11.22	12.41	13.60	14.80	16.00
1.00	1.38	1.96	2.66	3.47	4.37	5.36	6.42	7.53	8.69	9.87	11.08	12.30	13.53	14.76	16.00
1.00	1.00	1.55	2.23	3.04	3.95	4.97	6.06	7.23	8.43	9.67	10.92	12.19	13.46	14.73	16.00
1.00	1.00	1.00	1.68	2.49	3.43	4.49	5.65	6.88	8.15	9.45	10.76	12.07	13.38	14.69	16.00
1.00	1.00	1.00	1.00	1.82	2.79	3.91	5.16	6.49	7.85	9.22	10.59	11.95	13.30	14.65	16.00
1.00	1.00	1.00	1.00	1.00	2.00	3.20	4.60	6.06	7.54	8.99	10.42	11.84	13.23	14.62	16.00
1.00	1.00	1.00	1.00	1.00	1.00	2.29	3.97	5.64	7.24	8.78	10.28	11.74	13.17	14.59	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.35	5.27	7.00	8.62	10.17	11.67	13.13	14.57	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.15	5.10	6.88	8.54	10.11	11.63	13.10	14.56	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.15	5.10	6.88	8.54	10.11	11.63	13.10	14.56	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.35	5.27	7.00	8.62	10.17	11.67	13.13	14.57	16.00
1.00	1.00	1.00	1.00	1.00	1.00	2.29	3.97	5.64	7.24	8.78	10.28	11.74	13.17	14.59	16.00
1.00	1.00	1.00	1.00	1.00	2.00	3.20	4.60	6.06	7.53	8.99	10.42	11.83	13.23	14.62	16.00
1.00	1.00	1.00	1.00	1.82	2.79	3.91	5.16	6.49	7.85	9.22	10.58	11.95	13.30	14.65	16.00
1.00	1.00	1.00	1.68	2.49	3.43	4.48	5.64	6.87	8.15	9.45	10.75	12.06	13.38	14.69	16.00
1.00	1.00	1.55	2.23	3.03	3.95	4.96	6.06	7.22	8.43	9.66	10.92	12.18	13.45	14.73	16.00
1.00	1.38	1.95	2.66	3.46	4.37	5.35	6.41	7.52	8.68	9.87	11.07	12.30	13.53	14.76	16.00
1.00	1.58	2.23	2.98	3.80	4.70	5.67	6.70	7.78	8.90	10.04	11.21	12.40	13.59	14.80	16.00
1.00	1.69	2.43	3.21	4.06	4.97	5.93	6.94	8.00	9.09	10.20	11.34	12.49	13.66	14.83	16.00
1.00	1.77	2.56	3.39	4.27	5.18	6.14	7.15	8.18	9.25	10.34	11.45	12.58	13.71	14.85	16.00
1.00	1.83	2.66	3.53	4.42	5.35	6.32	7.31	8.34	9.39	10.46	11.55	12.65	13.76	14.88	16.00
1.00	1.87	2.74	3.63	4.55	5.49	6.45	7.45	8.46	9.50	10.56	11.63	12.71	13.80	14.90	16.00
1.00	1.90	2.80	3.71	4.65	5.60	6.57	7.56	8.57	9.60	10.64	11.70	12.77	13.84	14.92	16.00
1.00	1.92	2.84	3.78	4.72	5.69	6.66	7.65	8.66	9.68	10.72	11.76	12.81	13.87	14.93	16.00
1.00	1.94	2.88	3.83	4.79	5.76	6.74	7.73	8.74	9.75	10.78	11.81	12.85	13.90	14.95	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.80	9.81	10.83	11.86	12.89	13.92	14.96	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.86	8.86	9.87	10.88	11.90	12.92	13.94	14.97	16.00
1.00	1.98	2.96	3.94	4.93	5.92	6.91	7.91	8.91	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.95	8.96	9.96	10.96	11.97	12.97	13.98	14.99	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 8d (2)

Expanded view of guidebank abutment B'/B = 0.625 [scale 4:1]

	E				F				G				H				I				J
17	1.00	1.25	1.50	1.75	2.00	2.30	2.60	2.90	3.20	3.55	3.90	4.25	4.60	4.97	5.33	5.70	6.06	6.43	6.80	7.17	7.54
	1.00	1.15	1.35	1.57	1.80	2.10	2.40	2.71	3.02	3.37	3.72	4.09	4.45	4.83	5.20	5.58	5.96	6.33	6.71	7.09	7.46
	1.00	1.00	1.19	1.39	1.61	1.90	2.20	2.50	2.82	3.18	3.54	3.92	4.30	4.68	5.07	5.46	5.85	6.24	6.62	7.01	7.39
	1.00	1.00	1.00	1.20	1.42	1.70	1.98	2.28	2.59	2.97	3.36	3.75	4.14	4.54	4.94	5.34	5.74	6.14	6.53	6.93	7.31
18	1.00	1.00	1.00	1.00	1.23	1.48	1.76	2.04	2.29	2.75	3.17	3.57	3.97	4.40	4.82	5.23	5.64	6.05	6.45	6.85	7.24
	1.00	1.00	1.00	1.00	1.00	1.25	1.53	1.84	2.17	2.57	2.99	3.41	3.83	4.26	4.69	5.12	5.54	5.96	6.37	6.78	7.18
	1.00	1.00	1.00	1.00	1.00	1.00	1.28	1.60	1.97	2.38	2.81	3.24	3.68	4.13	4.58	5.01	5.45	5.87	6.29	6.71	7.12
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.72	2.16	2.62	3.08	3.53	4.00	4.46	4.92	5.36	5.80	6.23	6.65	7.06
19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.41	1.93	2.44	2.92	3.35	3.88	4.37	4.83	5.27	5.73	6.16	6.59	7.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.71	2.29	2.81	3.30	3.80	4.29	4.76	5.22	5.67	6.11	6.55	6.97
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.62	2.19	2.73	3.24	3.74	4.23	4.71	5.17	5.63	6.07	6.51	6.94
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.58	2.14	2.67	3.19	3.69	4.19	4.66	5.13	5.59	6.04	6.48	6.91
20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.56	2.10	2.64	3.15	3.66	4.15	4.63	5.10	5.56	6.01	6.46	6.88
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.55	2.09	2.62	3.13	3.64	4.13	4.62	5.09	5.55	6.00	6.44	6.88
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.54	2.08	2.61	3.13	3.63	4.13	4.61	5.08	5.54	6.00	6.44	6.88
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.54	2.08	2.61	3.13	3.64	4.13	4.62	5.09	5.55	6.00	6.44	6.88
21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.55	2.10	2.63	3.15	3.66	4.15	4.63	5.10	5.56	6.01	6.45	6.88
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.57	2.12	2.66	3.18	3.69	4.18	4.66	5.13	5.59	6.04	6.48	6.91
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.59	2.16	2.70	3.22	3.73	4.22	4.70	5.17	5.62	6.07	6.51	6.94
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.64	2.23	2.77	3.28	3.79	4.28	4.76	5.22	5.67	6.11	6.55	6.97
22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.74	2.34	2.87	3.35	3.87	4.36	4.82	5.27	5.72	6.16	6.59	7.00
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.44	1.98	2.51	3.02	3.50	3.98	4.45	4.91	5.35	5.79	6.22	6.65	7.06
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36	1.77	2.24	2.71	3.19	3.65	4.11	4.56	5.01	5.44	5.87	6.29	6.71	7.12
	1.00	1.00	1.00	1.00	1.00	1.00	1.32	1.67	2.05	2.48	2.92	3.37	3.81	4.25	4.68	5.11	5.54	5.95	6.37	6.78	7.18
23	1.00	1.00	1.00	1.00	1.00	1.29	1.61	1.94	2.29	2.71	3.13	3.55	3.97	4.39	4.81	5.22	5.64	6.04	6.45	6.85	7.24
	1.00	1.00	1.00	1.00	1.25	1.55	1.87	2.20	2.56	2.94	3.33	3.73	4.13	4.53	4.94	5.34	5.74	6.14	6.53	6.92	7.31
	1.00	1.00	1.00	1.25	1.50	1.81	2.12	2.45	2.79	3.15	3.52	3.91	4.29	4.68	5.07	5.46	5.85	6.23	6.62	7.00	7.39
	1.00	1.00	1.25	1.50	1.75	2.05	2.36	2.68	3.01	3.35	3.71	4.08	4.45	4.82	5.20	5.58	5.95	6.33	6.71	7.08	7.46
24	1.00	1.25	1.50	1.75	2.00	2.30	2.60	2.90	3.20	3.55	3.90	4.25	4.60	4.96	5.33	5.70	6.06	6.43	6.80	7.17	7.53

Figure 4a (1)

Global view of vertical wall abutment B'/B = 0.91

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 4a (2)

Expanded view of vertical wallabutment B'/B = 0.91 [scale 5:1]

	A					B					C					D					E
19	1.00	1.16	1.33	1.49	1.65	1.82	2.01	2.20	2.38	2.57	2.76	2.96	3.16	3.36	3.57	3.77	3.97	4.18	4.38	4.59	4.79
	1.00	1.16	1.32	1.48	1.64	1.81	1.99	2.18	2.36	2.55	2.75	2.95	3.15	3.35	3.55	3.75	3.96	4.16	4.37	4.58	4.78
	1.00	1.15	1.31	1.46	1.63	1.79	1.97	2.15	2.34	2.53	2.73	2.93	3.13	3.33	3.54	3.74	3.95	4.15	4.36	4.56	4.77
	1.00	1.15	1.29	1.45	1.60	1.77	1.94	2.13	2.31	2.51	2.70	2.90	3.11	3.31	3.52	3.73	3.93	4.14	4.35	4.55	4.76
	1.00	1.14	1.28	1.42	1.57	1.74	1.91	2.09	2.28	2.48	2.68	2.88	3.09	3.29	3.50	3.71	3.92	4.13	4.33	4.54	4.75
20	1.00	1.12	1.25	1.39	1.53	1.69	1.86	2.05	2.24	2.44	2.65	2.85	3.06	3.27	3.48	3.69	3.90	4.11	4.32	4.53	4.74
	1.00	1.11	1.22	1.34	1.48	1.63	1.81	2.00	2.20	2.40	2.61	2.83	3.04	3.25	3.47	3.68	3.89	4.10	4.31	4.52	4.73
	1.00	1.09	1.18	1.29	1.41	1.56	1.74	1.94	2.15	2.36	2.58	2.80	3.02	3.23	3.45	3.67	3.88	4.09	4.30	4.51	4.72
	1.00	1.06	1.13	1.21	1.31	1.45	1.64	1.86	2.09	2.32	2.54	2.77	2.99	3.22	3.43	3.65	3.87	4.08	4.29	4.51	4.72
	1.00	1.03	1.07	1.12	1.18	1.29	1.53	1.78	2.03	2.27	2.51	2.74	2.97	3.20	3.42	3.64	3.86	4.07	4.29	4.50	4.71
21	1.00	1.00	1.00	1.00	1.00	1.00	1.39	1.70	1.98	2.24	2.48	2.72	2.96	3.19	3.41	3.63	3.85	4.07	4.28	4.49	4.70
						1.00	1.34	1.66	1.94	2.21	2.46	2.71	2.94	3.18	3.40	3.62	3.84	4.06	4.28	4.49	4.70
						1.00	1.33	1.64	1.92	2.19	2.45	2.70	2.94	3.17	3.40	3.62	3.84	4.06	4.27	4.49	4.70
						1.00	1.33	1.64	1.92	2.19	2.45	2.70	2.94	3.17	3.40	3.62	3.84	4.06	4.27	4.49	4.70
						1.00	1.34	1.66	1.94	2.21	2.46	2.71	2.94	3.18	3.40	3.62	3.84	4.06	4.28	4.49	4.70
22	1.00	1.00	1.00	1.00	1.00	1.00	1.39	1.70	1.98	2.24	2.48	2.72	2.96	3.19	3.41	3.63	3.85	4.07	4.28	4.49	4.70
	1.00	1.03	1.07	1.12	1.18	1.29	1.53	1.78	2.03	2.27	2.51	2.74	2.97	3.20	3.42	3.64	3.86	4.07	4.29	4.50	4.71
	1.00	1.06	1.13	1.21	1.31	1.45	1.64	1.86	2.09	2.32	2.54	2.77	2.99	3.22	3.43	3.65	3.87	4.08	4.29	4.51	4.72
	1.00	1.09	1.18	1.29	1.41	1.56	1.74	1.94	2.15	2.36	2.58	2.80	3.02	3.23	3.45	3.67	3.88	4.09	4.30	4.51	4.72
	1.00	1.11	1.22	1.34	1.48	1.63	1.81	2.00	2.20	2.40	2.61	2.83	3.04	3.25	3.47	3.68	3.89	4.10	4.31	4.52	4.73
23	1.00	1.12	1.25	1.39	1.53	1.69	1.86	2.05	2.24	2.44	2.65	2.85	3.06	3.27	3.48	3.69	3.90	4.11	4.32	4.53	4.74
	1.00	1.14	1.28	1.42	1.57	1.74	1.91	2.09	2.28	2.48	2.68	2.88	3.09	3.29	3.50	3.71	3.92	4.13	4.33	4.54	4.75
	1.00	1.15	1.29	1.45	1.60	1.77	1.94	2.13	2.31	2.51	2.70	2.90	3.11	3.31	3.52	3.73	3.93	4.14	4.35	4.55	4.76
	1.00	1.15	1.31	1.46	1.63	1.79	1.97	2.15	2.34	2.53	2.73	2.93	3.13	3.33	3.54	3.74	3.95	4.15	4.36	4.56	4.77
	1.00	1.16	1.32	1.48	1.64	1.81	1.99	2.18	2.36	2.55	2.75	2.95	3.15	3.35	3.55	3.75	3.96	4.16	4.37	4.58	4.78
24	1.00	1.16	1.33	1.49	1.65	1.82	2.01	2.20	2.38	2.57	2.76	2.96	3.16	3.36	3.57	3.77	3.97	4.18	4.38	4.59	4.79

Figure 4b (1)

Global view of vertical wall abutment B'/B = 0.8125

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.96	6.96	7.95	8.96	9.96	10.96	11.97	12.97	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.96	3.95	4.94	5.93	6.92	7.92	8.92	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.95	3.93	4.92	5.91	6.90	7.90	8.90	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.88	7.87	8.88	9.89	10.90	11.92	12.94	13.96	14.98	16.00
1.00	1.96	2.92	3.89	4.87	5.85	6.84	7.84	8.85	9.86	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.95	2.90	3.86	4.83	5.81	6.80	7.81	8.81	9.83	10.85	11.88	12.91	13.94	14.97	16.00
1.00	1.93	2.87	3.82	4.78	5.76	6.75	7.76	8.77	9.80	10.82	11.85	12.89	13.92	14.96	16.00
1.00	1.91	2.83	3.77	4.72	5.70	6.69	7.70	8.72	9.75	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.88	2.77	3.69	4.64	5.62	6.62	7.64	8.67	9.71	10.75	11.80	12.85	13.90	14.95	16.00
1.00	1.83	2.69	3.59	4.53	5.51	6.52	7.56	8.60	9.65	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.77	2.57	3.44	4.37	5.37	6.41	7.46	8.53	9.60	10.67	11.74	12.80	13.87	14.94	16.00
1.00	1.67	2.39	3.21	4.16	5.20	6.27	7.36	8.45	9.54	10.63	11.71	12.78	13.86	14.93	16.00
1.00	1.52	2.11	2.86	3.86	4.98	6.12	7.26	8.38	9.49	10.59	11.68	12.77	13.85	14.92	16.00
1.00	1.29	1.66	2.25	3.46	4.74	5.97	7.16	8.32	9.45	10.56	11.66	12.75	13.84	14.92	16.00
1.00	1.00	1.00	1.00	3.00	4.54	5.87	7.11	8.29	9.43	10.55	11.65	12.75	13.83	14.92	16.00
1.00	1.00	1.00	1.00	3.00	4.54	5.87	7.11	8.29	9.43	10.55	11.65	12.75	13.83	14.92	16.00
1.00	1.29	1.66	2.25	3.46	4.74	5.97	7.16	8.32	9.45	10.56	11.66	12.75	13.84	14.92	16.00
1.00	1.52	2.11	2.86	3.86	4.98	6.12	7.26	8.38	9.49	10.59	11.68	12.77	13.85	14.92	16.00
1.00	1.67	2.39	3.21	4.16	5.20	6.27	7.36	8.45	9.54	10.63	11.71	12.78	13.86	14.93	16.00
1.00	1.77	2.57	3.44	4.37	5.37	6.41	7.46	8.53	9.60	10.67	11.74	12.80	13.87	14.94	16.00
1.00	1.83	2.69	3.59	4.53	5.51	6.52	7.56	8.60	9.65	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.88	2.77	3.69	4.64	5.62	6.62	7.64	8.67	9.71	10.75	11.80	12.85	13.90	14.95	16.00
1.00	1.91	2.83	3.77	4.72	5.70	6.69	7.70	8.72	9.75	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.93	2.87	3.82	4.78	5.76	6.75	7.76	8.77	9.80	10.82	11.85	12.89	13.92	14.96	16.00
1.00	1.95	2.90	3.86	4.83	5.81	6.80	7.81	8.81	9.83	10.85	11.88	12.91	13.94	14.97	16.00
1.00	1.96	2.92	3.89	4.87	5.85	6.84	7.84	8.85	9.86	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.88	7.87	8.88	9.89	10.90	11.92	12.94	13.96	14.98	16.00
1.00	1.98	2.95	3.93	4.92	5.91	6.90	7.90	8.90	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.98	2.96	3.95	4.94	5.93	6.92	7.92	8.92	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.96	6.96	7.95	8.96	9.96	10.96	11.97	12.97	13.98	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 4b (2)

Expanded view of vertical wall abutment B'/B = 0.8125 [scale 5:1]

	C					D					E					F					G
19	2.11	2.26	2.41	2.56	2.71	2.86	3.06	3.26	3.46	3.66	3.86	4.09	4.31	4.53	4.76	4.98	5.21	5.44	5.66	5.89	6.12
	2.02	2.16	2.31	2.46	2.62	2.78	2.97	3.17	3.37	3.58	3.80	4.02	4.25	4.47	4.70	4.93	5.16	5.40	5.63	5.86	6.09
	1.93	2.07	2.21	2.36	2.51	2.68	2.87	3.07	3.28	3.50	3.72	3.95	4.18	4.42	4.65	4.88	5.12	5.36	5.59	5.83	6.06
	1.84	1.97	2.10	2.24	2.40	2.57	2.76	2.97	3.19	3.41	3.64	3.88	4.11	4.35	4.59	4.84	5.08	5.32	5.56	5.79	6.03
	1.75	1.86	1.99	2.12	2.27	2.43	2.63	2.85	3.08	3.32	3.55	3.80	4.05	4.29	4.54	4.79	5.03	5.28	5.52	5.76	6.00
20	1.66	1.75	1.86	1.98	2.12	2.25	2.49	2.73	2.97	3.22	3.46	3.72	3.98	4.23	4.49	4.74	4.99	5.24	5.49	5.73	5.97
	1.53	1.62	1.72	1.84	1.98	2.14	2.36	2.60	2.86	3.11	3.38	3.64	3.91	4.17	4.43	4.69	4.95	5.20	5.46	5.71	5.95
	1.40	1.48	1.57	1.67	1.81	1.98	2.21	2.47	2.74	3.01	3.29	3.57	3.84	4.11	4.38	4.65	4.91	5.17	5.43	5.68	5.93
	1.26	1.32	1.39	1.48	1.60	1.77	2.03	2.31	2.61	2.90	3.20	3.49	3.78	4.06	4.34	4.61	4.88	5.14	5.40	5.66	5.91
	1.13	1.17	1.20	1.25	1.33	1.48	1.81	2.15	2.49	2.80	3.10	3.42	3.72	4.01	4.30	4.57	4.85	5.12	5.38	5.64	5.89
21	1.00	1.00	1.00	1.00	1.00	1.00	1.58	2.01	2.38	2.71	3.00	3.36	3.68	3.98	4.26	4.54	4.82	5.10	5.36	5.62	5.87
						1.00	1.49	1.93	2.31	2.67	2.99	3.33	3.65	3.95	4.25	4.53	4.81	5.08	5.35	5.61	5.87
						1.00	1.46	1.89	2.28	2.64	2.98	3.32	3.64	3.94	4.24	4.52	4.80	5.08	5.35	5.61	5.87
						1.00	1.46	1.89	2.28	2.64	2.98	3.32	3.63	3.94	4.24	4.52	4.80	5.08	5.35	5.61	5.87
						1.00	1.49	1.92	2.31	2.67	2.99	3.33	3.65	3.95	4.25	4.53	4.81	5.08	5.35	5.61	5.87
22	1.00	1.00	1.00	1.00	1.00	1.00	1.58	2.01	2.38	2.71	3.00	3.35	3.67	3.98	4.26	4.54	4.82	5.10	5.36	5.62	5.87
	1.13	1.16	1.20	1.25	1.33	1.47	1.80	2.15	2.48	2.80	3.10	3.42	3.72	4.01	4.30	4.57	4.85	5.12	5.38	5.64	5.89
	1.26	1.32	1.39	1.47	1.59	1.77	2.02	2.31	2.61	2.90	3.19	3.49	3.78	4.06	4.34	4.61	4.88	5.14	5.40	5.66	5.91
	1.40	1.47	1.56	1.67	1.80	1.98	2.20	2.46	2.73	3.01	3.28	3.56	3.84	4.11	4.38	4.65	4.91	5.17	5.43	5.68	5.93
	1.53	1.62	1.72	1.83	1.97	2.14	2.36	2.60	2.85	3.11	3.37	3.64	3.91	4.17	4.43	4.69	4.95	5.20	5.46	5.71	5.95
23	1.66	1.75	1.86	1.98	2.11	2.25	2.49	2.73	2.97	3.21	3.46	3.72	3.98	4.23	4.49	4.74	4.99	5.24	5.49	5.73	5.97
	1.75	1.86	1.98	2.11	2.26	2.42	2.63	2.85	3.08	3.31	3.55	3.80	4.04	4.29	4.54	4.79	5.03	5.28	5.52	5.76	6.00
	1.84	1.97	2.10	2.24	2.39	2.56	2.76	2.96	3.18	3.41	3.64	3.87	4.11	4.35	4.59	4.84	5.08	5.32	5.56	5.79	6.03
	1.93	2.07	2.21	2.35	2.51	2.68	2.87	3.07	3.28	3.50	3.72	3.95	4.18	4.41	4.65	4.88	5.12	5.36	5.59	5.83	6.06
	2.02	2.16	2.31	2.46	2.61	2.78	2.97	3.17	3.37	3.58	3.80	4.02	4.25	4.47	4.70	4.93	5.16	5.40	5.63	5.86	6.09
24	2.11	2.26	2.41	2.56	2.71	2.86	3.06	3.26	3.46	3.66	3.86	4.09	4.31	4.53	4.76	4.98	5.21	5.44	5.66	5.89	6.12

Figure 4c (1)

Global view of vertical wall abutment B'/B = 0.72

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.94	5.94	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.96	3.94	4.92	5.91	6.91	7.90	8.91	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.91	12.93	13.95	14.98	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.84	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.92	2.85	3.79	4.74	5.71	6.69	7.69	8.70	9.73	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.90	2.81	3.73	4.67	5.63	6.61	7.62	8.64	9.67	10.71	11.76	12.82	13.88	14.94	16.00
1.00	1.87	2.75	3.65	4.57	5.53	6.51	7.53	8.56	9.60	10.66	11.72	12.79	13.86	14.93	16.00
1.00	1.83	2.67	3.54	4.45	5.40	6.39	7.41	8.46	9.52	10.59	11.67	12.75	13.83	14.92	16.00
1.00	1.77	2.56	3.39	4.28	5.23	6.24	7.28	8.35	9.43	10.52	11.62	12.71	13.81	14.90	16.00
1.00	1.69	2.41	3.19	4.06	5.02	6.05	7.12	8.22	9.33	10.45	11.56	12.67	13.78	14.89	16.00
1.00	1.58	2.20	2.90	3.74	4.72	5.81	6.94	8.09	9.23	10.37	11.51	12.64	13.76	14.88	16.00
1.00	1.43	1.90	2.48	3.26	4.33	5.53	6.74	7.95	9.14	10.31	11.46	12.61	13.74	14.87	16.00
1.00	1.23	1.50	1.87	2.49	3.83	5.22	6.55	7.83	9.06	10.25	11.43	12.58	13.73	14.86	16.00
1.00	1.00	1.00	1.00	1.00	3.27	4.97	6.43	7.76	9.01	10.22	11.41	12.57	13.72	14.86	16.00
1.00	1.00	1.00	1.00	1.00	3.27	4.97	6.43	7.76	9.01	10.22	11.41	12.57	13.72	14.86	16.00
1.00	1.23	1.50	1.87	2.49	3.83	5.22	6.55	7.83	9.06	10.25	11.43	12.58	13.73	14.86	16.00
1.00	1.43	1.90	2.48	3.26	4.33	5.53	6.74	7.95	9.14	10.31	11.46	12.61	13.74	14.87	16.00
1.00	1.58	2.20	2.90	3.74	4.72	5.81	6.94	8.09	9.23	10.37	11.51	12.64	13.76	14.88	16.00
1.00	1.69	2.41	3.19	4.06	5.02	6.05	7.12	8.22	9.33	10.45	11.56	12.67	13.78	14.89	16.00
1.00	1.77	2.56	3.39	4.28	5.23	6.24	7.28	8.35	9.43	10.52	11.62	12.71	13.81	14.90	16.00
1.00	1.83	2.67	3.54	4.45	5.40	6.39	7.41	8.46	9.52	10.59	11.67	12.75	13.83	14.92	16.00
1.00	1.87	2.75	3.65	4.57	5.53	6.51	7.53	8.56	9.60	10.66	11.72	12.79	13.86	14.93	16.00
1.00	1.90	2.81	3.73	4.67	5.63	6.61	7.62	8.64	9.67	10.71	11.76	12.82	13.88	14.94	16.00
1.00	1.92	2.85	3.79	4.74	5.71	6.69	7.69	8.70	9.73	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.84	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.91	12.93	13.95	14.98	16.00
1.00	1.98	2.96	3.94	4.92	5.91	6.91	7.90	8.91	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.98	2.97	3.95	4.94	5.94	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 4c (2)

Expanded view of vertical wall abutment B'/B = 0.72 [scale 5:1]

	D					E					F					G					H
19	2.48	2.64	2.79	2.95	3.11	3.26	3.48	3.69	3.90	4.12	4.33	4.57	4.81	5.05	5.29	5.53	5.77	6.01	6.26	6.50	6.74
	2.36	2.51	2.66	2.82	2.98	3.16	3.36	3.57	3.79	4.02	4.25	4.49	4.73	4.97	5.22	5.47	5.71	5.96	6.21	6.46	6.70
	2.24	2.38	2.53	2.69	2.85	3.03	3.24	3.45	3.68	3.91	4.15	4.40	4.65	4.90	5.15	5.40	5.66	5.91	6.16	6.42	6.67
	2.11	2.25	2.39	2.54	2.70	2.89	3.09	3.32	3.56	3.80	4.05	4.30	4.56	4.82	5.08	5.34	5.60	5.86	6.12	6.37	6.63
	1.99	2.11	2.24	2.38	2.54	2.71	2.94	3.18	3.43	3.68	3.94	4.21	4.48	4.75	5.01	5.28	5.55	5.81	6.07	6.33	6.59
20	1.87	1.96	2.08	2.21	2.35	2.49	2.76	3.02	3.29	3.56	3.83	4.11	4.39	4.67	4.95	5.22	5.49	5.76	6.03	6.30	6.55
	1.69	1.79	1.90	2.03	2.18	2.36	2.60	2.87	3.15	3.43	3.72	4.01	4.31	4.60	4.88	5.16	5.44	5.72	5.99	6.26	6.53
	1.52	1.61	1.70	1.82	1.97	2.16	2.41	2.70	3.00	3.31	3.61	3.92	4.22	4.52	4.82	5.11	5.40	5.68	5.96	6.23	6.50
	1.35	1.41	1.49	1.58	1.71	1.91	2.19	2.52	2.85	3.18	3.50	3.83	4.15	4.46	4.76	5.06	5.35	5.64	5.92	6.20	6.48
	1.17	1.21	1.25	1.31	1.39	1.56	1.94	2.33	2.70	3.05	3.39	3.74	4.08	4.40	4.71	5.02	5.32	5.61	5.90	6.18	6.45
21	1.00	1.00	1.00	1.00	1.00	1.00	1.66	2.16	2.57	2.95	3.27	3.67	4.02	4.36	4.67	4.97	5.29	5.59	5.88	6.16	6.43
						1.00	1.56	2.06	2.50	2.89	3.26	3.63	3.99	4.33	4.65	4.96	5.27	5.57	5.86	6.15	6.43
						1.00	1.52	2.01	2.46	2.87	3.25	3.62	3.97	4.31	4.64	4.95	5.26	5.56	5.86	6.15	6.43
						1.00	1.52	2.01	2.46	2.87	3.25	3.62	3.97	4.31	4.64	4.95	5.26	5.56	5.86	6.15	6.43
						1.00	1.56	2.06	2.50	2.89	3.26	3.63	3.99	4.33	4.65	4.96	5.27	5.57	5.86	6.15	6.43
22	1.00	1.00	1.00	1.00	1.00	1.00	1.66	2.16	2.57	2.95	3.27	3.67	4.02	4.36	4.67	4.97	5.29	5.59	5.88	6.16	6.43
	1.17	1.21	1.25	1.31	1.39	1.56	1.94	2.33	2.70	3.05	3.39	3.74	4.08	4.40	4.71	5.02	5.32	5.61	5.90	6.18	6.45
	1.35	1.41	1.49	1.58	1.71	1.91	2.19	2.52	2.85	3.18	3.50	3.83	4.15	4.46	4.76	5.06	5.35	5.64	5.92	6.20	6.48
	1.52	1.61	1.70	1.82	1.97	2.16	2.41	2.70	3.00	3.31	3.61	3.92	4.22	4.52	4.82	5.11	5.40	5.68	5.96	6.23	6.50
	1.69	1.79	1.90	2.03	2.18	2.36	2.60	2.87	3.15	3.43	3.72	4.01	4.31	4.60	4.88	5.16	5.44	5.72	5.99	6.26	6.53
23	1.87	1.96	2.08	2.21	2.35	2.49	2.76	3.02	3.29	3.56	3.83	4.11	4.39	4.67	4.95	5.22	5.49	5.76	6.03	6.30	6.55
	1.99	2.11	2.24	2.38	2.54	2.71	2.94	3.18	3.43	3.68	3.94	4.21	4.48	4.75	5.01	5.28	5.55	5.81	6.07	6.33	6.59
	2.11	2.25	2.39	2.54	2.70	2.89	3.09	3.32	3.56	3.80	4.05	4.30	4.56	4.82	5.08	5.34	5.60	5.86	6.12	6.37	6.63
	2.24	2.38	2.53	2.69	2.85	3.03	3.24	3.45	3.68	3.91	4.15	4.40	4.65	4.90	5.15	5.40	5.66	5.91	6.16	6.42	6.67
	2.36	2.51	2.66	2.82	2.98	3.16	3.36	3.57	3.79	4.02	4.25	4.49	4.73	4.97	5.22	5.47	5.71	5.96	6.21	6.46	6.70
24	2.48	2.64	2.79	2.95	3.11	3.26	3.48	3.69	3.90	4.12	4.33	4.57	4.81	5.05	5.29	5.53	5.77	6.01	6.26	6.50	6.74

Figure 4d (1)

Global view of vertical wall abutment B'/B = 0.625

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.90	8.90	9.91	10.92	11.93	12.94	13.96	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.87	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.96	2.92	3.89	4.86	5.84	6.82	7.82	8.82	9.83	10.85	11.87	12.90	13.93	14.96	16.00
1.00	1.95	2.90	3.86	4.82	5.79	6.77	7.76	8.77	9.78	10.80	11.83	12.87	13.91	14.95	16.00
1.00	1.93	2.87	3.82	4.77	5.73	6.71	7.70	8.71	9.72	10.75	11.79	12.83	13.89	14.94	16.00
1.00	1.92	2.84	3.77	4.71	5.66	6.63	7.62	8.63	9.65	10.69	11.74	12.79	13.86	14.93	16.00
1.00	1.89	2.79	3.70	4.63	5.58	6.54	7.53	8.54	9.57	10.62	11.68	12.75	13.83	14.91	16.00
1.00	1.87	2.74	3.63	4.53	5.47	6.43	7.41	8.43	9.47	10.53	11.60	12.69	13.79	14.89	16.00
1.00	1.83	2.67	3.53	4.41	5.33	6.28	7.27	8.30	9.35	10.42	11.52	12.63	13.75	14.87	16.00
1.00	1.79	2.58	3.41	4.26	5.16	6.10	7.10	8.13	9.20	10.30	11.42	12.56	13.70	14.85	16.00
1.00	1.73	2.47	3.25	4.07	4.94	5.88	6.88	7.93	9.03	10.16	11.31	12.47	13.64	14.82	16.00
1.00	1.66	2.33	3.05	3.82	4.66	5.59	6.60	7.69	8.82	9.99	11.18	12.38	13.59	14.79	16.00
1.00	1.57	2.16	2.79	3.49	4.29	5.21	6.26	7.39	8.59	9.81	11.05	12.29	13.53	14.76	16.00
1.00	1.46	1.93	2.46	3.07	3.80	4.71	5.82	7.04	8.32	9.61	10.91	12.19	13.47	14.73	16.00
1.00	1.32	1.66	2.05	2.52	3.14	4.02	5.26	6.64	8.04	9.42	10.77	12.10	13.41	14.71	16.00
1.00	1.17	1.35	1.56	1.83	2.23	2.95	4.56	6.21	7.78	9.25	10.67	12.03	13.37	14.69	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.81	5.87	7.60	9.15	10.61	12.00	13.35	14.68	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.81	5.87	7.60	9.15	10.61	12.00	13.35	14.68	16.00
1.00	1.17	1.35	1.56	1.83	2.23	2.95	4.56	6.21	7.78	9.25	10.67	12.03	13.37	14.69	16.00
1.00	1.32	1.66	2.05	2.52	3.14	4.02	5.26	6.64	8.04	9.42	10.77	12.10	13.41	14.71	16.00
1.00	1.46	1.93	2.46	3.07	3.80	4.71	5.82	7.04	8.32	9.61	10.91	12.19	13.47	14.73	16.00
1.00	1.57	2.16	2.79	3.49	4.29	5.21	6.26	7.39	8.59	9.81	11.05	12.29	13.53	14.76	16.00
1.00	1.66	2.33	3.05	3.82	4.66	5.59	6.60	7.69	8.82	9.99	11.18	12.38	13.59	14.79	16.00
1.00	1.73	2.47	3.25	4.07	4.94	5.88	6.88	7.93	9.03	10.16	11.31	12.47	13.64	14.82	16.00
1.00	1.79	2.58	3.41	4.26	5.16	6.10	7.10	8.13	9.20	10.30	11.42	12.56	13.70	14.85	16.00
1.00	1.83	2.67	3.53	4.41	5.33	6.28	7.27	8.30	9.35	10.42	11.52	12.63	13.75	14.87	16.00
1.00	1.87	2.74	3.63	4.53	5.47	6.43	7.41	8.43	9.47	10.53	11.60	12.69	13.79	14.89	16.00
1.00	1.89	2.79	3.70	4.63	5.58	6.54	7.53	8.54	9.57	10.62	11.68	12.75	13.83	14.91	16.00
1.00	1.92	2.84	3.77	4.71	5.66	6.63	7.62	8.63	9.65	10.69	11.74	12.79	13.86	14.93	16.00
1.00	1.93	2.87	3.82	4.77	5.73	6.71	7.70	8.71	9.72	10.75	11.79	12.83	13.89	14.94	16.00
1.00	1.95	2.90	3.86	4.82	5.79	6.77	7.76	8.77	9.78	10.80	11.83	12.87	13.91	14.95	16.00
1.00	1.96	2.92	3.89	4.86	5.84	6.82	7.82	8.82	9.83	10.85	11.87	12.90	13.93	14.96	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.87	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.90	8.90	9.91	10.92	11.93	12.94	13.96	14.98	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.99	2.99	3.98	4.98	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 4d (2)

Expanded view of vertical wall abutment B'/B = 0.625 [scale 5:1]

	F					G					H					I					J
19	3.14	3.32	3.49	3.67	3.84	4.02	4.26	4.51	4.76	5.01	5.26	5.53	5.81	6.09	6.36	6.64	6.92	7.20	7.48	7.76	8.04
	2.96	3.13	3.30	3.48	3.67	3.87	4.10	4.35	4.61	4.87	5.13	5.41	5.70	5.98	6.27	6.55	6.84	7.13	7.41	7.70	7.99
	2.78	2.94	3.11	3.29	3.48	3.69	3.93	4.18	4.45	4.72	5.00	5.29	5.58	5.88	6.17	6.47	6.76	7.06	7.35	7.64	7.93
	2.60	2.75	2.91	3.08	3.27	3.49	3.73	4.00	4.28	4.56	4.86	5.16	5.46	5.77	6.08	6.38	6.68	6.99	7.29	7.58	7.88
	2.41	2.55	2.70	2.86	3.04	3.25	3.52	3.80	4.10	4.40	4.71	5.03	5.35	5.66	5.98	6.30	6.61	6.92	7.22	7.53	7.83
20	2.23	2.34	2.47	2.62	2.79	2.95	3.28	3.59	3.91	4.24	4.56	4.90	5.23	5.56	5.89	6.21	6.53	6.85	7.17	7.48	7.78
	1.98	2.10	2.22	2.37	2.55	2.77	3.06	3.38	3.72	4.07	4.41	4.77	5.11	5.46	5.80	6.13	6.47	6.79	7.11	7.43	7.74
	1.74	1.84	1.95	2.09	2.27	2.50	2.81	3.16	3.53	3.90	4.27	4.64	5.00	5.36	5.72	6.06	6.40	6.74	7.06	7.39	7.71
	1.49	1.57	1.66	1.77	1.93	2.17	2.52	2.92	3.33	3.73	4.12	4.51	4.90	5.28	5.64	5.99	6.34	6.68	7.02	7.35	7.67
	1.25	1.29	1.34	1.41	1.51	1.72	2.19	2.67	3.13	3.56	3.97	4.40	4.81	5.20	5.57	5.93	6.29	6.64	6.98	7.31	7.64
21	1.00	1.00	1.00	1.00	1.00	1.00	1.83	2.45	2.97	3.42	3.81	4.30	4.73	5.14	5.52	5.87	6.25	6.61	6.95	7.28	7.60
						1.00	1.70	2.32	2.86	3.35	3.80	4.26	4.69	5.10	5.49	5.86	6.23	6.59	6.93	7.27	7.60
						1.00	1.65	2.26	2.81	3.32	3.78	4.24	4.67	5.08	5.47	5.85	6.22	6.58	6.93	7.27	7.60
						1.00	1.65	2.26	2.81	3.32	3.78	4.24	4.67	5.08	5.47	5.85	6.22	6.58	6.93	7.27	7.60
						1.00	1.70	2.32	2.86	3.35	3.80	4.26	4.69	5.10	5.49	5.86	6.23	6.59	6.93	7.27	7.60
22	1.00	1.00	1.00	1.00	1.00	1.00	1.83	2.45	2.97	3.42	3.81	4.30	4.73	5.14	5.52	5.87	6.25	6.61	6.95	7.28	7.60
	1.25	1.29	1.34	1.41	1.51	1.72	2.19	2.67	3.13	3.56	3.97	4.40	4.81	5.20	5.57	5.93	6.29	6.64	6.98	7.31	7.64
	1.49	1.57	1.66	1.77	1.93	2.17	2.52	2.92	3.33	3.73	4.12	4.51	4.90	5.28	5.64	5.99	6.34	6.68	7.02	7.35	7.67
	1.74	1.84	1.95	2.09	2.27	2.50	2.81	3.16	3.53	3.90	4.27	4.64	5.00	5.36	5.72	6.06	6.40	6.74	7.06	7.39	7.71
	1.98	2.10	2.22	2.37	2.55	2.77	3.06	3.38	3.72	4.07	4.41	4.77	5.11	5.46	5.80	6.13	6.47	6.79	7.11	7.43	7.74
23	2.23	2.34	2.47	2.62	2.79	2.95	3.28	3.59	3.91	4.24	4.56	4.90	5.23	5.56	5.89	6.21	6.53	6.85	7.17	7.48	7.78
	2.41	2.55	2.70	2.86	3.04	3.25	3.52	3.80	4.10	4.40	4.71	5.03	5.35	5.66	5.98	6.30	6.61	6.92	7.22	7.53	7.83
	2.60	2.75	2.91	3.08	3.27	3.49	3.73	4.00	4.28	4.56	4.86	5.16	5.46	5.77	6.08	6.38	6.68	6.99	7.29	7.58	7.88
	2.78	2.94	3.11	3.29	3.48	3.69	3.93	4.18	4.45	4.72	5.00	5.29	5.58	5.88	6.17	6.47	6.76	7.06	7.35	7.64	7.93
	2.96	3.13	3.30	3.48	3.67	3.87	4.10	4.35	4.61	4.87	5.13	5.41	5.70	5.98	6.27	6.55	6.84	7.13	7.41	7.70	7.99
24	3.14	3.32	3.49	3.67	3.84	4.02	4.26	4.51	4.76	5.01	5.26	5.53	5.81	6.09	6.36	6.64	6.92	7.20	7.48	7.76	8.04

Figure 5a (1)

Global view of spill through abutment B'/B=0.91

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Expanded view of spill through abutment B'/B = 0.91 [scale 5:1]

	A					B					C					D					E
20	1.00	1.12	1.24	1.36	1.49	1.61	1.81	2.01	2.21	2.41	2.61	2.83	3.04	3.25	3.46	3.68	3.89	4.10	4.31	4.53	4.74
	1.00	1.11	1.22	1.34	1.46	1.61	1.79	1.98	2.18	2.38	2.59	2.80	3.01	3.23	3.45	3.66	3.88	4.09	4.30	4.52	4.73
	1.00	1.09	1.19	1.30	1.43	1.58	1.75	1.94	2.14	2.35	2.56	2.77	2.99	3.21	3.43	3.64	3.86	4.08	4.29	4.51	4.72
	1.00	1.07	1.15	1.24	1.37	1.52	1.70	1.90	2.10	2.31	2.52	2.74	2.96	3.19	3.41	3.63	3.85	4.07	4.28	4.50	4.72
	1.00	1.04	1.08	1.15	1.28	1.44	1.64	1.84	2.05	2.26	2.47	2.71	2.94	3.17	3.39	3.61	3.83	4.06	4.28	4.49	4.71
21	1.00	1.00	1.00	1.00	1.15	1.34	1.56	1.78	2.01	2.22	2.40	2.67	2.92	3.15	3.38	3.59	3.82	4.05	4.27	4.49	4.70
	1.00	1.00	1.00	1.00	1.00	1.20	1.47	1.73	1.97	2.20	2.43	2.67	2.91	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
	1.00	1.00	1.00	1.00	1.00	1.00	1.39	1.69	1.95	2.19	2.43	2.67	2.90	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
	1.00	1.00	1.00	1.00	1.00	1.00	1.39	1.69	1.95	2.19	2.43	2.67	2.90	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
	1.00	1.00	1.00	1.00	1.00	1.20	1.47	1.73	1.97	2.20	2.43	2.67	2.91	3.14	3.37	3.59	3.82	4.04	4.26	4.48	4.70
22	1.00	1.00	1.00	1.00	1.15	1.34	1.56	1.78	2.01	2.22	2.40	2.67	2.92	3.15	3.38	3.59	3.82	4.05	4.27	4.49	4.70
	1.00	1.04	1.08	1.15	1.28	1.44	1.64	1.84	2.05	2.26	2.47	2.71	2.94	3.17	3.39	3.61	3.83	4.06	4.28	4.49	4.71
	1.00	1.07	1.15	1.24	1.37	1.52	1.70	1.90	2.10	2.31	2.52	2.74	2.96	3.19	3.41	3.63	3.85	4.07	4.28	4.50	4.72
	1.00	1.09	1.19	1.30	1.43	1.58	1.75	1.94	2.14	2.35	2.56	2.77	2.99	3.21	3.43	3.64	3.86	4.08	4.29	4.51	4.72
	1.00	1.11	1.22	1.34	1.46	1.61	1.79	1.98	2.18	2.38	2.59	2.80	3.01	3.23	3.45	3.66	3.88	4.09	4.30	4.52	4.73
23	1.00	1.12	1.24	1.36	1.49	1.61	1.81	2.01	2.21	2.41	2.61	2.83	3.04	3.25	3.46	3.68	3.89	4.10	4.31	4.53	4.74

Figure 5b (1)

Global view of spill through abutment B'/B = 0.8125

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.96	6.96	7.95	8.96	9.96	10.96	11.97	12.97	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.96	3.95	4.94	5.93	6.92	7.92	8.92	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.95	3.93	4.92	5.91	6.90	7.90	8.90	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.88	7.87	8.88	9.89	10.90	11.92	12.94	13.96	14.98	16.00
1.00	1.96	2.92	3.89	4.87	5.85	6.84	7.84	8.85	9.86	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.95	2.90	3.86	4.83	5.81	6.80	7.81	8.81	9.83	10.85	11.88	12.91	13.94	14.97	16.00
1.00	1.93	2.87	3.82	4.78	5.76	6.75	7.76	8.77	9.80	10.82	11.85	12.89	13.92	14.96	16.00
1.00	1.91	2.83	3.77	4.72	5.70	6.69	7.70	8.72	9.75	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.88	2.77	3.69	4.64	5.62	6.62	7.64	8.67	9.71	10.75	11.80	12.85	13.90	14.95	16.00
1.00	1.83	2.69	3.59	4.53	5.51	6.52	7.56	8.60	9.65	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.77	2.57	3.44	4.37	5.37	6.41	7.46	8.53	9.60	10.67	11.74	12.80	13.87	14.94	16.00
1.00	1.67	2.39	3.21	4.16	5.20	6.27	7.36	8.45	9.54	10.63	11.71	12.78	13.86	14.93	16.00
1.00	1.52	2.11	2.86	3.86	4.98	6.12	7.26	8.38	9.49	10.59	11.68	12.77	13.85	14.92	16.00
1.00	1.29	1.66	2.25	3.46	4.74	5.97	7.16	8.32	9.45	10.56	11.66	12.75	13.84	14.92	16.00
1.00	1.00	1.00	1.00	3.00	4.54	5.87	7.11	8.29	9.43	10.55	11.65	12.75	13.83	14.92	16.00
1.00	1.00	1.00	1.00	3.00	4.54	5.87	7.11	8.29	9.43	10.55	11.65	12.75	13.83	14.92	16.00
1.00	1.29	1.66	2.25	3.46	4.74	5.97	7.16	8.32	9.45	10.56	11.66	12.75	13.84	14.92	16.00
1.00	1.52	2.11	2.86	3.86	4.98	6.12	7.26	8.38	9.49	10.59	11.68	12.77	13.85	14.92	16.00
1.00	1.67	2.39	3.21	4.16	5.20	6.27	7.36	8.45	9.54	10.63	11.71	12.78	13.86	14.93	16.00
1.00	1.77	2.57	3.44	4.37	5.37	6.41	7.46	8.53	9.60	10.67	11.74	12.80	13.87	14.94	16.00
1.00	1.83	2.69	3.59	4.53	5.51	6.52	7.56	8.60	9.65	10.71	11.77	12.83	13.88	14.94	16.00
1.00	1.88	2.77	3.69	4.64	5.62	6.62	7.64	8.67	9.71	10.75	11.80	12.85	13.90	14.95	16.00
1.00	1.91	2.83	3.77	4.72	5.70	6.69	7.70	8.72	9.75	10.79	11.83	12.87	13.91	14.96	16.00
1.00	1.93	2.87	3.82	4.78	5.76	6.75	7.76	8.77	9.80	10.82	11.85	12.89	13.92	14.96	16.00
1.00	1.95	2.90	3.86	4.83	5.81	6.80	7.81	8.81	9.83	10.85	11.88	12.91	13.94	14.97	16.00
1.00	1.96	2.92	3.89	4.87	5.85	6.84	7.84	8.85	9.86	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.88	7.87	8.88	9.89	10.90	11.92	12.94	13.96	14.98	16.00
1.00	1.98	2.95	3.93	4.92	5.91	6.90	7.90	8.90	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.98	2.96	3.95	4.94	5.93	6.92	7.92	8.92	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.96	6.96	7.95	8.96	9.96	10.96	11.97	12.97	13.98	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.99	12.99	13.99	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Expanded view of spill through abutment B'/B = 0.8125 [scale 5:1]

	C					D					E					F					G
20	1.66	1.78	1.89	2.01	2.13	2.25	2.49	2.73	2.98	3.22	3.46	3.72	3.97	4.23	4.48	4.74	4.99	5.23	5.48	5.73	5.97
	1.53	1.64	1.75	1.88	2.02	2.19	2.40	2.64	2.89	3.14	3.39	3.65	3.91	4.17	4.43	4.69	4.95	5.20	5.45	5.70	5.95
	1.40	1.50	1.60	1.73	1.89	2.08	2.30	2.54	2.79	3.05	3.31	3.58	3.85	4.12	4.38	4.65	4.91	5.17	5.42	5.68	5.93
	1.26	1.34	1.43	1.55	1.72	1.93	2.17	2.43	2.69	2.96	3.23	3.51	3.79	4.07	4.34	4.61	4.87	5.13	5.39	5.65	5.91
	1.13	1.18	1.23	1.33	1.52	1.76	2.03	2.31	2.59	2.86	3.13	3.44	3.73	4.02	4.30	4.57	4.84	5.10	5.37	5.63	5.89
21	1.00	1.00	1.00	1.00	1.27	1.55	1.87	2.19	2.49	2.77	3.00	3.37	3.69	3.98	4.27	4.54	4.81	5.08	5.34	5.60	5.87
	1.00	1.00	1.00	1.00	1.00	1.32	1.71	2.09	2.43	2.74	3.03	3.35	3.66	3.96	4.25	4.52	4.80	5.06	5.31	5.55	5.76
	1.00	1.00	1.00	1.00	1.00	1.00	1.58	2.02	2.39	2.72	3.03	3.35	3.65	3.95	4.24	4.52	4.79	5.05	5.30	5.54	5.76
	1.00	1.00	1.00	1.00	1.00	1.00	1.58	2.02	2.39	2.72	3.03	3.35	3.65	3.95	4.24	4.52	4.79	5.05	5.30	5.54	5.76
	1.00	1.00	1.00	1.00	1.00	1.32	1.71	2.09	2.43	2.74	3.03	3.35	3.66	3.96	4.25	4.52	4.80	5.06	5.31	5.55	5.76
22	1.00	1.00	1.00	1.00	1.27	1.55	1.87	2.19	2.49	2.77	3.00	3.37	3.69	3.98	4.27	4.54	4.81	5.08	5.34	5.60	5.87
	1.13	1.18	1.23	1.33	1.52	1.76	2.03	2.31	2.59	2.86	3.13	3.44	3.73	4.02	4.30	4.57	4.84	5.10	5.37	5.63	5.89
	1.26	1.34	1.43	1.55	1.72	1.93	2.17	2.43	2.69	2.96	3.23	3.51	3.79	4.07	4.34	4.61	4.87	5.13	5.39	5.65	5.91
	1.40	1.50	1.60	1.73	1.89	2.08	2.30	2.54	2.79	3.05	3.31	3.58	3.85	4.12	4.38	4.65	4.91	5.17	5.42	5.68	5.93
	1.53	1.64	1.75	1.88	2.02	2.19	2.40	2.64	2.89	3.14	3.39	3.65	3.91	4.17	4.43	4.69	4.95	5.20	5.45	5.70	5.95
23	1.66	1.78	1.89	2.01	2.13	2.25	2.49	2.73	2.98	3.22	3.46	3.72	3.97	4.23	4.48	4.74	4.99	5.23	5.48	5.73	5.97

Figure 5c (1)

Global view of spill through abutment B'/B = 0.72

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.94	5.94	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.96	3.94	4.92	5.91	6.91	7.90	8.91	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.91	12.93	13.95	14.98	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.84	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.92	2.85	3.79	4.74	5.71	6.69	7.69	8.70	9.73	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.90	2.81	3.73	4.67	5.63	6.61	7.62	8.64	9.67	10.71	11.76	12.82	13.88	14.94	16.00
1.00	1.87	2.75	3.65	4.57	5.53	6.51	7.53	8.56	9.60	10.66	11.72	12.79	13.86	14.93	16.00
1.00	1.83	2.67	3.54	4.45	5.40	6.39	7.41	8.46	9.52	10.59	11.67	12.75	13.83	14.92	16.00
1.00	1.77	2.56	3.39	4.28	5.23	6.24	7.28	8.35	9.43	10.52	11.62	12.71	13.81	14.90	16.00
1.00	1.69	2.41	3.19	4.06	5.02	6.05	7.12	8.22	9.33	10.45	11.56	12.67	13.78	14.89	16.00
1.00	1.58	2.20	2.90	3.74	4.72	5.81	6.94	8.09	9.23	10.37	11.51	12.64	13.76	14.88	16.00
1.00	1.43	1.90	2.48	3.26	4.33	5.53	6.74	7.95	9.14	10.31	11.46	12.61	13.74	14.87	16.00
1.00	1.23	1.50	1.87	2.49	3.83	5.22	6.55	7.83	9.06	10.25	11.43	12.58	13.73	14.86	16.00
1.00	1.00	1.00	1.00	1.00	3.27	4.97	6.43	7.76	9.01	10.22	11.41	12.57	13.72	14.86	16.00
1.00	1.00	1.00	1.00	1.00	3.27	4.97	6.43	7.76	9.01	10.22	11.41	12.57	13.72	14.86	16.00
1.00	1.23	1.50	1.87	2.49	3.83	5.22	6.55	7.83	9.06	10.25	11.43	12.58	13.73	14.86	16.00
1.00	1.43	1.90	2.48	3.26	4.33	5.53	6.74	7.95	9.14	10.31	11.46	12.61	13.74	14.87	16.00
1.00	1.58	2.20	2.90	3.74	4.72	5.81	6.94	8.09	9.23	10.37	11.51	12.64	13.76	14.88	16.00
1.00	1.69	2.41	3.19	4.06	5.02	6.05	7.12	8.22	9.33	10.45	11.56	12.67	13.78	14.89	16.00
1.00	1.77	2.56	3.39	4.28	5.23	6.24	7.28	8.35	9.43	10.52	11.62	12.71	13.81	14.90	16.00
1.00	1.83	2.67	3.54	4.45	5.40	6.39	7.41	8.46	9.52	10.59	11.67	12.75	13.83	14.92	16.00
1.00	1.87	2.75	3.65	4.57	5.53	6.51	7.53	8.56	9.60	10.66	11.72	12.79	13.86	14.93	16.00
1.00	1.90	2.81	3.73	4.67	5.63	6.61	7.62	8.64	9.67	10.71	11.76	12.82	13.88	14.94	16.00
1.00	1.92	2.85	3.79	4.74	5.71	6.69	7.69	8.70	9.73	10.76	11.80	12.85	13.90	14.95	16.00
1.00	1.94	2.88	3.83	4.79	5.77	6.75	7.75	8.76	9.78	10.80	11.84	12.87	13.91	14.96	16.00
1.00	1.95	2.91	3.87	4.84	5.82	6.80	7.80	8.81	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.96	2.93	3.90	4.87	5.86	6.84	7.84	8.85	9.86	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.97	2.94	3.92	4.90	5.89	6.88	7.88	8.88	9.89	10.90	11.91	12.93	13.95	14.98	16.00
1.00	1.98	2.96	3.94	4.92	5.91	6.91	7.90	8.91	9.91	10.92	11.93	12.95	13.96	14.98	16.00
1.00	1.98	2.97	3.95	4.94	5.94	6.93	7.93	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 5c (2)

Expanded view of spill through abutment B'/B = 0.72 [scale 5:1]

	D					E					F					G					H
20	1.87	1.99	2.12	2.24	2.36	2.49	2.76	3.02	3.29	3.56	3.83	4.11	4.38	4.66	4.94	5.22	5.49	5.75	6.02	6.29	6.55
	1.69	1.81	1.94	2.07	2.23	2.41	2.65	2.91	3.18	3.46	3.74	4.02	4.31	4.60	4.88	5.16	5.44	5.71	5.99	6.26	6.53
	1.52	1.63	1.75	1.89	2.06	2.27	2.52	2.78	3.06	3.35	3.64	3.94	4.23	4.53	4.82	5.11	5.40	5.68	5.95	6.23	6.50
	1.35	1.43	1.53	1.67	1.86	2.09	2.36	2.65	2.94	3.24	3.54	3.85	4.16	4.47	4.77	5.06	5.35	5.64	5.92	6.20	6.48
	1.17	1.22	1.29	1.39	1.61	1.88	2.19	2.51	2.82	3.12	3.42	3.76	4.09	4.41	4.72	5.02	5.32	5.61	5.90	6.18	6.45
21	1.00	1.00	1.00	1.00	1.31	1.64	2.00	2.36	2.71	3.02	3.27	3.68	4.04	4.37	4.68	4.97	5.29	5.59	5.88	6.16	6.43
	1.00	1.00	1.00	1.00	1.00	1.36	1.82	2.24	2.63	2.97	3.30	3.66	4.01	4.34	4.66	4.97	5.27	5.57	5.86	6.15	6.43
	1.00	1.00	1.00	1.00	1.00	1.00	1.66	2.16	2.58	2.95	3.30	3.65	4.00	4.33	4.65	4.96	5.27	5.57	5.86	6.14	6.43
	1.00	1.00	1.00	1.00	1.00	1.00	1.66	2.16	2.58	2.95	3.30	3.65	4.00	4.33	4.65	4.96	5.27	5.57	5.86	6.14	6.43
	1.00	1.00	1.00	1.00	1.00	1.36	1.82	2.24	2.63	2.97	3.30	3.66	4.01	4.34	4.66	4.97	5.27	5.57	5.86	6.15	6.43
22	1.00	1.00	1.00	1.00	1.31	1.64	2.00	2.36	2.71	3.02	3.27	3.68	4.04	4.37	4.68	4.97	5.29	5.59	5.88	6.16	6.43
	1.17	1.22	1.29	1.39	1.61	1.88	2.19	2.51	2.82	3.12	3.42	3.76	4.09	4.41	4.72	5.02	5.32	5.61	5.90	6.18	6.45
	1.35	1.43	1.53	1.67	1.86	2.09	2.36	2.65	2.94	3.24	3.54	3.85	4.16	4.47	4.77	5.06	5.35	5.64	5.92	6.20	6.48
	1.52	1.63	1.75	1.89	2.06	2.27	2.52	2.78	3.06	3.35	3.64	3.94	4.23	4.53	4.82	5.11	5.40	5.68	5.95	6.23	6.50
	1.69	1.81	1.94	2.07	2.23	2.41	2.65	2.91	3.18	3.46	3.74	4.02	4.31	4.60	4.88	5.16	5.44	5.71	5.99	6.26	6.53
23	1.87	1.99	2.12	2.24	2.36	2.49	2.76	3.02	3.29	3.56	3.83	4.11	4.38	4.66	4.94	5.22	5.49	5.75	6.02	6.29	6.55

Figure 5d (1)

Global view of spill through abutment B'/B = 0.625

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.90	8.90	9.91	10.92	11.93	12.94	13.96	14.98	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.87	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.96	2.92	3.89	4.86	5.84	6.82	7.82	8.82	9.83	10.85	11.87	12.90	13.93	14.96	16.00
1.00	1.95	2.90	3.86	4.82	5.79	6.77	7.76	8.77	9.78	10.80	11.83	12.87	13.91	14.95	16.00
1.00	1.93	2.87	3.82	4.77	5.73	6.71	7.70	8.71	9.72	10.75	11.79	12.83	13.89	14.94	16.00
1.00	1.92	2.81	3.77	4.71	5.66	6.63	7.62	8.63	9.65	10.69	11.74	12.79	13.86	14.93	16.00
1.00	1.89	2.79	3.70	4.63	5.58	6.54	7.53	8.54	9.57	10.62	11.68	12.75	13.83	14.91	16.00
1.00	1.87	2.74	3.63	4.53	5.47	6.43	7.41	8.43	9.47	10.53	11.60	12.69	13.79	14.89	16.00
1.00	1.83	2.67	3.53	4.41	5.33	6.28	7.27	8.30	9.35	10.42	11.52	12.63	13.75	14.87	16.00
1.00	1.79	2.58	3.41	4.26	5.16	6.10	7.10	8.13	9.20	10.30	11.42	12.56	13.70	14.85	16.00
1.00	1.73	2.47	3.25	4.07	4.94	5.88	6.88	7.93	9.03	10.16	11.31	12.47	13.64	14.82	16.00
1.00	1.66	2.33	3.05	3.82	4.66	5.59	6.60	7.69	8.82	9.99	11.18	12.38	13.59	14.79	16.00
1.00	1.57	2.16	2.79	3.49	4.29	5.21	6.26	7.39	8.59	9.81	11.05	12.29	13.53	14.76	16.00
1.00	1.46	1.93	2.46	3.07	3.80	4.71	5.82	7.04	8.32	9.61	10.91	12.19	13.47	14.73	16.00
1.00	1.32	1.66	2.05	2.52	3.14	4.02	5.26	6.64	8.04	9.42	10.77	12.10	13.41	14.71	16.00
1.00	1.17	1.35	1.56	1.83	2.23	2.95	4.56	6.21	7.78	9.25	10.67	12.03	13.37	14.69	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.81	5.87	7.60	9.15	10.61	12.00	13.35	14.68	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.81	5.87	7.60	9.15	10.61	12.00	13.35	14.68	16.00
1.00	1.17	1.35	1.56	1.83	2.23	2.95	4.56	6.21	7.78	9.25	10.67	12.03	13.37	14.69	16.00
1.00	1.32	1.66	2.05	2.52	3.14	4.02	5.26	6.64	8.04	9.42	10.77	12.10	13.41	14.71	16.00
1.00	1.46	1.93	2.46	3.07	3.80	4.71	5.82	7.04	8.32	9.61	10.91	12.19	13.47	14.73	16.00
1.00	1.57	2.16	2.79	3.49	4.29	5.21	6.26	7.39	8.59	9.81	11.05	12.29	13.53	14.76	16.00
1.00	1.66	2.33	3.05	3.82	4.66	5.59	6.60	7.69	8.82	9.99	11.18	12.38	13.59	14.79	16.00
1.00	1.73	2.47	3.25	4.07	4.94	5.88	6.88	7.93	9.03	10.16	11.31	12.47	13.64	14.82	16.00
1.00	1.79	2.58	3.41	4.26	5.16	6.10	7.10	8.13	9.20	10.30	11.42	12.56	13.70	14.85	16.00
1.00	1.83	2.67	3.53	4.41	5.33	6.28	7.27	8.30	9.35	10.42	11.52	12.63	13.75	14.87	16.00
1.00	1.87	2.74	3.63	4.53	5.47	6.43	7.41	8.43	9.47	10.53	11.60	12.69	13.79	14.89	16.00
1.00	1.89	2.79	3.70	4.63	5.58	6.54	7.53	8.54	9.57	10.62	11.68	12.75	13.83	14.91	16.00
1.00	1.92	2.84	3.77	4.71	5.66	6.63	7.62	8.63	9.65	10.69	11.74	12.79	13.86	14.93	16.00
1.00	1.93	2.87	3.82	4.77	5.73	6.71	7.70	8.71	9.72	10.75	11.79	12.83	13.89	14.94	16.00
1.00	1.95	2.90	3.86	4.82	5.79	6.77	7.76	8.77	9.78	10.80	11.83	12.87	13.91	14.95	16.00
1.00	1.96	2.92	3.89	4.86	5.84	6.82	7.82	8.82	9.83	10.85	11.87	12.90	13.93	14.96	16.00
1.00	1.97	2.94	3.92	4.90	5.88	6.87	7.86	8.86	9.87	10.88	11.90	12.92	13.95	14.97	16.00
1.00	1.98	2.96	3.94	4.93	5.91	6.91	7.90	8.90	9.91	10.92	11.93	12.94	13.96	14.98	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.99	2.99	3.98	4.98	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 3b (2)

Expanded view of spill through abutment B'/B = 0.625 [scale 5:1]

	F					G					H					I					J
20	2.23	2.37	2.52	2.66	2.81	2.95	3.27	3.59	3.91	4.24	4.56	4.89	5.22	5.55	5.88	6.21	6.52	6.84	7.15	7.46	7.78
	1.98	2.12	2.27	2.43	2.61	2.83	3.12	3.44	3.76	4.10	4.43	4.77	5.12	5.46	5.80	6.13	6.46	6.78	7.10	7.42	7.74
	1.74	1.87	2.01	2.18	2.39	2.64	2.94	3.27	3.61	3.95	4.30	4.66	5.02	5.37	5.72	6.06	6.40	6.73	7.06	7.38	7.71
	1.49	1.60	1.72	1.88	2.12	2.40	2.73	3.09	3.44	3.80	4.17	4.54	4.92	5.29	5.65	6.00	6.34	6.68	7.02	7.35	7.67
	1.25	1.31	1.38	1.51	1.79	2.13	2.51	2.90	3.28	3.65	4.01	4.43	4.83	5.21	5.58	5.94	6.29	6.64	6.98	7.31	7.64
21	1.00	1.00	1.00	1.00	1.40	1.81	2.26	2.71	3.13	3.51	3.81	4.32	4.75	5.15	5.53	5.87	6.25	6.61	6.95	7.28	7.60
	1.00	1.00	1.00	1.00	1.00	1.46	2.02	2.55	3.03	3.45	3.85	4.29	4.72	5.12	5.50	5.87	6.23	6.59	6.94	7.27	7.60
	1.00	1.00	1.00	1.00	1.00	1.00	1.82	2.45	2.97	3.42	3.85	4.28	4.70	5.10	5.49	5.86	6.22	6.58	6.93	7.27	7.60
	1.00	1.00	1.00	1.00	1.00	1.00	1.82	2.45	2.97	3.42	3.85	4.28	4.70	5.10	5.49	5.86	6.22	6.58	6.93	7.27	7.60
	1.00	1.00	1.00	1.00	1.00	1.46	2.02	2.55	3.03	3.45	3.85	4.29	4.72	5.12	5.50	5.87	6.23	6.59	6.94	7.27	7.60
22	1.00	1.00	1.00	1.00	1.40	1.81	2.26	2.71	3.13	3.51	3.81	4.32	4.75	5.15	5.53	5.87	6.25	6.61	6.95	7.28	7.60
	1.25	1.31	1.38	1.51	1.79	2.13	2.51	2.90	3.28	3.65	4.01	4.43	4.83	5.21	5.58	5.94	6.29	6.64	6.98	7.31	7.64
	1.49	1.60	1.72	1.88	2.12	2.40	2.73	3.09	3.44	3.80	4.17	4.54	4.92	5.29	5.65	6.00	6.34	6.68	7.02	7.35	7.67
	1.74	1.87	2.01	2.18	2.39	2.64	2.94	3.27	3.61	3.95	4.30	4.66	5.02	5.37	5.72	6.06	6.40	6.73	7.06	7.38	7.71
	1.98	2.12	2.27	2.43	2.61	2.83	3.12	3.44	3.76	4.10	4.43	4.77	5.12	5.46	5.80	6.13	6.46	6.78	7.10	7.42	7.74
23	2.23	2.37	2.52	2.66	2.81	2.95	3.27	3.59	3.91	4.24	4.56	4.89	5.22	5.55	5.88	6.21	6.52	6.84	7.15	7.46	7.78

Figure 6a (1)

Global view of guidebank abutment B'/B = 0.91

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.00	2.40	3.59	4.70	5.77	6.82	7.85	8.88	9.90	10.92	11.94	12.96	13.97	14.99	16.00
1.00	1.61	2.61	3.68	4.74	5.79	6.83	7.86	8.88	9.91	10.93	11.94	12.96	13.97	14.99	16.00
1.00	1.82	2.76	3.77	4.79	5.82	6.85	7.87	8.89	9.91	10.93	11.95	12.96	13.97	14.99	16.00
1.00	1.90	2.85	3.83	4.84	5.85	6.87	7.89	8.90	9.92	10.94	11.95	12.96	13.98	14.99	16.00
1.00	1.94	2.90	3.88	4.88	5.88	6.89	7.90	8.92	9.93	10.94	11.95	12.97	13.98	14.99	16.00
1.00	1.96	2.93	3.91	4.91	5.91	6.91	7.92	8.93	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.97	2.95	3.94	4.93	5.93	6.93	7.93	8.94	9.95	10.96	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.95	5.94	6.94	7.95	8.95	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.96	5.95	6.95	7.96	8.96	9.96	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.98	4.97	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	5.99	6.99	7.99	8.99	9.99	10.99	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 6a (2)

Expanded view of guidebank abutment B"/B = 0.91 [scale 4:1]

	A				B				C				D				E
19	1.00	1.20	1.41	1.61	1.82	2.05	2.29	2.53	2.76	3.01	3.26	3.52	3.77	4.02	4.28	4.54	4.79
	1.00	1.19	1.39	1.58	1.79	2.02	2.25	2.49	2.73	2.98	3.24	3.49	3.75	4.00	4.26	4.52	4.77
	1.00	1.18	1.36	1.55	1.75	1.97	2.20	2.45	2.70	2.95	3.21	3.46	3.72	3.98	4.24	4.50	4.76
	1.00	1.16	1.32	1.50	1.69	1.91	2.15	2.40	2.65	2.91	3.17	3.44	3.70	3.96	4.23	4.49	4.75
20	1.00	1.13	1.27	1.43	1.61	1.83	2.08	2.34	2.61	2.87	3.14	3.41	3.68	3.94	4.21	4.47	4.74
	1.00	1.10	1.21	1.33	1.50	1.73	2.00	2.27	2.55	2.83	3.11	3.38	3.65	3.92	4.19	4.46	4.73
	1.00	1.06	1.13	1.20	1.33	1.61	1.91	2.21	2.50	2.79	3.07	3.35	3.63	3.91	4.18	4.45	4.72
	1.00	1.03	1.04	1.00	1.00	1.45	1.82	2.14	2.45	2.75	3.04	3.33	3.61	3.89	4.17	4.44	4.71
21	1.00	1.00	1.00	1.00	1.00	1.40	1.76	2.09	2.40	2.72	3.02	3.31	3.59	3.88	4.16	4.43	4.70
	1.00	1.00	1.00	1.00	1.00	1.38	1.74	2.07	2.39	2.71	3.01	3.30	3.59	3.87	4.15	4.43	4.70
	1.00	1.00	1.00	1.00	1.00	1.38	1.73	2.07	2.39	2.70	3.00	3.30	3.59	3.87	4.15	4.43	4.70
	1.00	1.00	1.00	1.00	1.00	1.39	1.75	2.08	2.40	2.71	3.01	3.30	3.59	3.87	4.15	4.43	4.70
22	1.00	1.00	1.00	1.00	1.00	1.44	1.80	2.11	2.40	2.72	3.02	3.31	3.59	3.88	4.16	4.43	4.70
	1.00	1.05	1.10	1.18	1.31	1.58	1.88	2.17	2.46	2.76	3.05	3.33	3.61	3.89	4.17	4.44	4.71
	1.00	1.09	1.19	1.31	1.47	1.70	1.97	2.24	2.52	2.80	3.08	3.36	3.63	3.91	4.18	4.45	4.72
	1.00	1.12	1.25	1.39	1.57	1.79	2.04	2.30	2.57	2.84	3.11	3.38	3.65	3.93	4.19	4.46	4.73
23	1.00	1.15	1.29	1.45	1.61	1.86	2.10	2.36	2.61	2.88	3.14	3.41	3.68	3.94	4.21	4.48	4.74
	1.00	1.16	1.33	1.51	1.70	1.92	2.16	2.41	2.66	2.92	3.18	3.44	3.70	3.96	4.23	4.49	4.75
	1.00	1.18	1.36	1.55	1.76	1.98	2.21	2.45	2.70	2.95	3.21	3.47	3.72	3.98	4.24	4.50	4.76
	1.00	1.19	1.39	1.59	1.80	2.02	2.25	2.49	2.73	2.98	3.24	3.49	3.75	4.00	4.26	4.52	4.77
24	1.00	1.20	1.41	1.61	1.82	2.05	2.29	2.53	2.76	3.01	3.26	3.52	3.77	4.02	4.28	4.54	4.79

Figure 6b (1)

Global view of guidebank abutment B'/B = 0.8125

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	2.00	2.99	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	13.99	15.00	16.00
1.00	1.99	2.99	3.98	4.98	5.97	6.97	7.97	8.97	9.97	10.98	11.98	12.98	13.99	14.99	16.00
1.00	1.99	2.98	3.97	4.97	5.96	6.96	7.96	8.96	9.96	10.96	11.97	12.98	13.98	14.99	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.94	8.94	9.94	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.96	3.95	4.94	5.93	6.92	7.92	8.92	9.93	10.93	11.94	12.96	13.97	14.98	16.00
1.00	1.98	2.95	3.93	4.92	5.90	6.90	7.89	8.90	9.90	10.92	11.93	12.94	13.96	14.98	16.00
1.00	1.97	2.94	3.91	4.89	5.88	6.87	7.87	8.87	9.88	10.89	11.91	12.93	13.95	14.98	16.00
1.00	1.96	2.92	3.89	4.86	5.84	6.83	7.83	8.84	9.85	10.87	11.89	12.92	13.94	14.97	16.00
1.00	1.95	2.90	3.85	4.82	5.80	6.79	7.79	8.80	9.82	10.84	11.87	12.90	13.93	14.97	16.00
1.00	1.93	2.86	3.81	4.77	5.75	6.74	7.74	8.75	9.78	10.81	11.84	12.88	13.92	14.96	16.00
1.00	1.91	2.82	3.75	4.70	5.68	6.67	7.68	8.70	9.73	10.77	11.81	12.86	13.90	14.95	16.00
1.00	1.87	2.76	3.67	4.62	5.59	6.59	7.60	8.64	9.68	10.73	11.78	12.83	13.89	14.94	16.00
1.00	1.83	2.68	3.57	4.50	5.48	6.48	7.52	8.56	9.62	10.68	11.74	12.81	13.87	14.94	16.00
1.00	1.76	2.56	3.41	4.34	5.33	6.36	7.41	8.48	9.55	10.63	11.71	12.78	13.85	14.93	16.00
1.00	1.66	2.37	3.18	4.12	5.14	6.21	7.30	8.39	9.49	10.58	11.67	12.76	13.84	14.92	16.00
1.00	1.52	2.09	2.83	3.81	4.91	6.04	7.18	8.31	9.43	10.54	11.64	12.73	13.82	14.91	16.00
1.00	1.31	1.66	2.22	3.39	4.64	5.87	7.06	8.23	9.37	10.50	11.61	12.72	13.81	14.91	16.00
1.00	1.08	1.00	1.00	2.89	4.39	5.73	6.98	8.17	9.33	10.47	11.59	12.70	13.81	14.90	16.00
1.00	1.00	1.00	1.00	2.77	4.31	5.68	6.95	8.15	9.32	10.46	11.59	12.70	13.80	14.90	16.00
1.00	1.00	1.00	1.00	2.89	4.39	5.73	6.98	8.17	9.33	10.47	11.59	12.70	13.81	14.90	16.00
1.00	1.29	1.65	2.21	3.39	4.64	5.87	7.06	8.23	9.37	10.50	11.61	12.72	13.81	14.91	16.00
1.00	1.51	2.09	2.82	3.81	4.91	6.04	7.18	8.31	9.42	10.54	11.64	12.73	13.82	14.91	16.00
1.00	1.66	2.37	3.18	4.12	5.14	6.21	7.30	8.39	9.49	10.58	11.67	12.76	13.84	14.92	16.00
1.00	1.76	2.55	3.41	4.34	5.33	6.36	7.41	8.48	9.55	10.63	11.71	12.78	13.85	14.93	16.00
1.00	1.83	2.68	3.56	4.50	5.47	6.48	7.52	8.56	9.62	10.68	11.74	12.81	13.87	14.94	16.00
1.00	1.87	2.76	3.67	4.61	5.59	6.59	7.60	8.64	9.68	10.72	11.78	12.83	13.89	14.94	16.00
1.00	1.91	2.82	3.75	4.70	5.68	6.67	7.68	8.70	9.73	10.77	11.81	12.86	13.90	14.95	16.00
1.00	1.93	2.86	3.81	4.77	5.74	6.73	7.74	8.75	9.78	10.81	11.84	12.88	13.92	14.96	16.00
1.00	1.95	2.89	3.85	4.82	5.80	6.79	7.79	8.80	9.82	10.84	11.87	12.90	13.93	14.96	16.00
1.00	1.96	2.92	3.88	4.86	5.84	6.83	7.83	8.84	9.85	10.87	11.89	12.91	13.94	14.97	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.87	7.86	8.87	9.88	10.89	11.91	12.93	13.95	14.98	16.00
1.00	1.97	2.95	3.93	4.91	5.90	6.89	7.89	8.89	9.90	10.91	11.93	12.94	13.96	14.98	16.00
1.00	1.98	2.96	3.95	4.93	5.92	6.92	7.91	8.92	9.92	10.93	11.94	12.95	13.97	14.98	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.93	8.94	9.94	10.95	11.95	12.96	13.98	14.99	16.00
1.00	1.99	2.98	3.97	4.96	5.96	6.95	7.95	8.95	9.95	10.96	11.97	12.97	13.98	14.99	16.00
1.00	1.99	2.98	3.98	4.97	5.97	6.97	7.96	8.97	9.97	10.97	11.97	12.98	13.99	14.99	16.00
1.00	1.99	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	2.00	3.00	3.99	4.99	5.99	6.99	7.99	8.99	9.99	10.99	11.99	12.99	14.00	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 6b (2)

Expanded view of guidebank abutment B'/B = 0.8125 [scale 4:1]

	C				D				E				F				G
18	2.09	2.28	2.46	2.64	2.83	3.07	3.32	3.56	3.81	4.08	4.36	4.63	4.91	5.19	5.47	5.76	6.04
	1.98	2.15	2.33	2.51	2.72	2.95	3.20	3.45	3.72	3.99	4.27	4.56	4.84	5.13	5.42	5.71	6.00
	1.87	2.02	2.18	2.36	2.57	2.81	3.07	3.34	3.61	3.90	4.19	4.48	4.78	5.07	5.36	5.66	5.95
	1.77	1.87	2.01	2.19	2.41	2.66	2.93	3.21	3.50	3.80	4.10	4.40	4.71	5.01	5.31	5.61	5.91
19	1.66	1.70	1.79	1.97	2.22	2.48	2.77	3.07	3.39	3.70	4.01	4.32	4.64	4.95	5.26	5.56	5.87
	1.49	1.47	1.49	1.69	1.97	2.27	2.59	2.93	3.26	3.59	3.92	4.25	4.57	4.89	5.21	5.52	5.83
	1.33	1.20	1.00	1.34	1.68	2.05	2.41	2.78	3.13	3.49	3.83	4.17	4.51	4.84	5.16	5.48	5.80
	1.16	1.00	1.00	1.00	1.37	1.82	2.24	2.63	3.01	3.39	3.75	4.10	4.45	4.78	5.12	5.44	5.76
20	1.00	1.00	1.00	1.00	1.00	1.61	2.09	2.51	2.89	3.30	3.68	4.04	4.39	4.74	5.08	5.41	5.73
	1.00	1.00	1.00	1.00	1.00	1.52	2.00	2.44	2.84	3.25	3.63	4.00	4.36	4.71	5.05	5.39	5.72
	1.00	1.00	1.00	1.00	1.00	1.48	1.95	2.39	2.80	3.21	3.60	3.97	4.33	4.69	5.03	5.37	5.70
	1.00	1.00	1.00	1.00	1.00	1.47	1.92	2.36	2.78	3.19	3.58	3.95	4.32	4.67	5.02	5.36	5.69
21	1.00	1.00	1.00	1.00	1.00	1.46	1.92	2.35	2.77	3.18	3.57	3.94	4.31	4.67	5.01	5.35	5.68
	1.00	1.00	1.00	1.00	1.00	1.47	1.93	2.36	2.78	3.19	3.58	3.95	4.32	4.67	5.02	5.36	5.69
	1.00	1.00	1.00	1.00	1.00	1.49	1.96	2.39	2.81	3.21	3.60	3.97	4.33	4.69	5.03	5.37	5.70
	1.00	1.00	1.00	1.00	1.00	1.53	2.01	2.44	2.85	3.25	3.63	4.00	4.36	4.71	5.05	5.38	5.71
22	1.00	1.00	1.00	1.00	1.00	1.64	2.11	2.53	2.89	3.30	3.68	4.04	4.39	4.74	5.08	5.41	5.73
	1.16	1.21	1.27	1.36	1.52	1.89	2.28	2.66	3.02	3.39	3.75	4.10	4.45	4.78	5.12	5.44	5.76
	1.32	1.41	1.51	1.65	1.84	2.13	2.46	2.80	3.15	3.49	3.84	4.17	4.51	4.83	5.16	5.48	5.80
	1.49	1.59	1.72	1.87	2.06	2.33	2.63	2.95	3.27	3.60	3.92	4.25	4.57	4.89	5.21	5.52	5.83
23	1.65	1.76	1.90	2.05	2.21	2.50	2.79	3.09	3.39	3.70	4.01	4.33	4.64	4.95	5.26	5.56	5.87
	1.76	1.90	2.06	2.23	2.43	2.67	2.94	3.22	3.51	3.80	4.10	4.40	4.71	5.01	5.31	5.61	5.91
	1.87	2.03	2.20	2.38	2.59	2.82	3.08	3.34	3.62	3.90	4.19	4.48	4.77	5.07	5.36	5.66	5.95
	1.98	2.15	2.33	2.52	2.72	2.95	3.20	3.45	3.72	3.99	4.27	4.56	4.84	5.13	5.42	5.71	6.00
24	2.09	2.27	2.45	2.64	2.82	3.07	3.31	3.56	3.81	4.08	4.36	4.63	4.91	5.19	5.47	5.76	6.04

Figure 6c (1)

Global view of guidebank abutment B'/B = 0.72

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.99	2.99	3.99	4.98	5.98	6.98	7.98	8.98	9.98	10.98	11.98	12.99	13.99	15.00	16.00
1.00	1.99	2.98	3.97	4.96	5.96	6.95	7.95	8.95	9.96	10.96	11.97	12.97	13.98	14.99	16.00
1.00	1.98	2.97	3.95	4.94	5.93	6.93	7.92	8.93	9.93	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.98	2.95	3.93	4.92	5.90	6.90	7.89	8.90	9.90	10.91	11.93	12.94	13.96	14.98	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.86	8.86	9.87	10.89	11.90	12.92	13.95	14.97	16.00
1.00	1.96	2.92	3.88	4.85	5.83	6.82	7.82	8.82	9.84	10.85	11.88	12.90	13.93	14.97	16.00
1.00	1.94	2.89	3.85	4.81	5.79	6.77	7.77	8.78	9.79	10.82	11.85	12.88	13.92	14.96	16.00
1.00	1.93	2.86	3.80	4.76	5.73	6.71	7.71	8.72	9.74	10.77	11.81	12.85	13.90	14.95	16.00
1.00	1.91	2.82	3.75	4.69	5.66	6.64	7.64	8.65	9.68	10.72	11.77	12.82	13.88	14.94	16.00
1.00	1.88	2.77	3.68	4.61	5.56	6.55	7.55	8.57	9.61	10.66	11.72	12.79	13.86	14.93	16.00
1.00	1.84	2.70	3.58	4.49	5.45	6.43	7.44	8.48	9.53	10.60	11.67	12.75	13.83	14.92	16.00
1.00	1.79	2.60	3.45	4.35	5.29	6.29	7.31	8.37	9.44	10.52	11.61	12.71	13.80	14.90	16.00
1.00	1.72	2.47	3.27	4.15	5.10	6.11	7.16	8.24	9.33	10.44	11.55	12.66	13.77	14.89	16.00
1.00	1.62	2.28	3.02	3.88	4.84	5.89	6.98	8.09	9.22	10.35	11.49	12.62	13.75	14.87	16.00
1.00	1.49	2.02	2.65	3.49	4.51	5.62	6.77	7.94	9.10	10.27	11.42	12.57	13.72	14.86	16.00
1.00	1.32	1.66	2.06	2.94	4.08	5.31	6.55	7.78	8.99	10.19	11.37	12.53	13.69	14.85	16.00
1.00	1.15	1.22	1.00	2.12	3.56	4.98	6.34	7.64	8.90	10.12	11.32	12.50	13.67	14.84	16.00
1.00	1.05	1.07	1.00	1.00	3.06	4.71	6.18	7.54	8.83	10.08	11.29	12.48	13.66	14.83	16.00
1.00	1.00	1.00	1.00	1.00	2.95	4.64	6.14	7.52	8.82	10.07	11.28	12.48	13.66	14.83	16.00
1.00	1.00	1.00	1.00	1.00	3.11	4.76	6.22	7.56	8.85	10.09	11.30	12.49	13.67	14.84	16.00
1.00	1.23	1.49	1.85	2.44	3.72	5.07	6.40	7.68	8.92	10.14	11.33	12.51	13.68	14.84	16.00
1.00	1.42	1.89	2.45	3.21	4.25	5.42	6.62	7.83	9.03	10.21	11.38	12.55	13.70	14.85	16.00
1.00	1.57	2.18	2.87	3.69	4.66	5.73	6.85	7.99	9.15	10.30	11.44	12.59	13.73	14.86	16.00
1.00	1.68	2.39	3.16	4.01	4.96	5.98	7.05	8.15	9.26	10.39	11.51	12.63	13.76	14.88	16.00
1.00	1.76	2.54	3.37	4.25	5.19	6.19	7.22	8.29	9.38	10.47	11.57	12.68	13.79	14.89	16.00
1.00	1.82	2.65	3.52	4.42	5.36	6.35	7.37	8.41	9.48	10.55	11.63	12.72	13.81	14.91	16.00
1.00	1.86	2.73	3.63	4.55	5.50	6.48	7.49	8.52	9.56	10.62	11.69	12.76	13.84	14.92	16.00
1.00	1.89	2.79	3.71	4.65	5.60	6.59	7.59	8.61	9.64	10.69	11.74	12.80	13.86	14.93	16.00
1.00	1.92	2.84	3.77	4.72	5.69	6.67	7.67	8.68	9.71	10.74	11.78	12.83	13.89	14.94	16.00
1.00	1.94	2.88	3.82	4.78	5.75	6.74	7.73	8.74	9.76	10.79	11.82	12.86	13.91	14.95	16.00
1.00	1.95	2.90	3.86	4.83	5.80	6.79	7.79	8.79	9.81	10.83	11.85	12.89	13.92	14.96	16.00
1.00	1.96	2.92	3.89	4.86	5.84	6.83	7.83	8.83	9.84	10.86	11.88	12.91	13.94	14.97	16.00
1.00	1.97	2.94	3.92	4.89	5.88	6.87	7.87	8.87	9.88	10.89	11.91	12.93	13.95	14.97	16.00
1.00	1.98	2.95	3.94	4.92	5.91	6.90	7.90	8.90	9.90	10.91	11.93	12.94	13.96	14.98	16.00
1.00	1.98	2.97	3.95	4.94	5.93	6.92	7.92	8.92	9.93	10.93	11.94	12.96	13.97	14.98	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.94	8.95	9.95	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.99	2.98	3.98	4.97	5.97	6.97	7.96	8.96	9.97	10.97	11.97	12.98	13.99	14.99	16.00
1.00	2.00	2.99	3.99	4.99	5.98	6.98	7.98	8.98	9.98	10.99	11.99	12.99	13.99	15.00	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 6c (2)

Expanded view of guidebank abutment B'/B = 0.72 [scale 4:1]

	C				D				E				F				G				H
18	1.66	1.76	1.86	1.96	2.06	2.28	2.50	2.72	2.94	3.22	3.51	3.79	4.08	4.38	4.69	5.00	5.31	5.62	5.93	6.24	6.55
	1.55	1.61	1.67	1.74	1.83	2.01	2.24	2.49	2.75	3.04	3.34	3.64	3.95	4.27	4.59	4.90	5.22	5.54	5.86	6.18	6.49
	1.44	1.47	1.49	1.49	1.51	1.71	1.96	2.24	2.54	2.85	3.17	3.49	3.82	4.15	4.48	4.81	5.14	5.47	5.79	6.12	6.44
	1.33	1.34	1.32	1.24	1.00	1.34	1.66	1.98	2.33	2.65	2.99	3.34	3.69	4.03	4.38	4.72	5.06	5.39	5.73	6.06	6.39
19	1.22	1.23	1.21	1.14	1.00	1.00	1.34	1.70	2.12	2.44	2.80	3.18	3.56	3.91	4.27	4.63	4.98	5.33	5.67	6.01	6.34
	1.18	1.17	1.15	1.10	1.04	1.00	1.00	1.37	1.78	2.18	2.60	3.01	3.41	3.79	4.17	4.54	4.90	5.26	5.61	5.96	6.30
	1.14	1.13	1.11	1.08	1.04	1.02	1.00	1.00	1.42	1.92	2.40	2.85	3.27	3.68	4.08	4.46	4.83	5.20	5.56	5.91	6.26
	1.11	1.10	1.08	1.06	1.04	1.02	1.01	1.00	1.00	1.68	2.23	2.71	3.16	3.58	3.99	4.39	4.77	5.15	5.51	5.87	6.22
20	1.07	1.07	1.06	1.05	1.03	1.02	1.01	1.00	1.00	1.59	2.12	2.61	3.06	3.50	3.93	4.33	4.71	5.10	5.47	5.83	6.18
	1.05	1.05	1.04	1.03	1.02	1.02	1.01	1.00	1.00	1.54	2.06	2.54	3.00	3.45	3.88	4.29	4.68	5.07	5.44	5.81	6.17
	1.03	1.03	1.03	1.02	1.02	1.01	1.01	1.00	1.00	1.52	2.02	2.51	2.97	3.42	3.84	4.26	4.66	5.05	5.43	5.80	6.16
	1.02	1.02	1.01	1.01	1.01	1.01	1.00	1.00	1.00	1.51	2.01	2.49	2.95	3.40	3.83	4.24	4.64	5.04	5.42	5.79	6.15
21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.51	2.01	2.49	2.95	3.40	3.83	4.24	4.64	5.03	5.41	5.78	6.14
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.52	2.02	2.51	2.97	3.41	3.84	4.26	4.66	5.05	5.43	5.80	6.16
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.54	2.06	2.55	3.00	3.45	3.87	4.28	4.68	5.07	5.45	5.81	6.18
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.60	2.13	2.61	3.06	3.50	3.92	4.33	4.72	5.10	5.47	5.84	6.20
22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.72	2.25	2.71	3.11	3.57	3.99	4.38	4.76	5.14	5.51	5.87	6.22
	1.12	1.15	1.17	1.20	1.23	1.27	1.33	1.43	1.61	2.02	2.46	2.87	3.27	3.68	4.08	4.46	4.83	5.20	5.56	5.91	6.26
	1.24	1.29	1.34	1.39	1.45	1.53	1.63	1.78	1.99	2.31	2.67	3.05	3.42	3.80	4.18	4.55	4.91	5.27	5.62	5.96	6.31
	1.37	1.43	1.50	1.57	1.66	1.76	1.89	2.05	2.26	2.55	2.88	3.22	3.57	3.93	4.29	4.64	4.99	5.34	5.68	6.02	6.35
23	1.49	1.56	1.65	1.74	1.85	1.97	2.12	2.28	2.44	2.76	3.07	3.39	3.72	4.06	4.40	4.74	5.07	5.41	5.74	6.07	6.40
	1.59	1.69	1.79	1.90	2.02	2.16	2.32	2.50	2.71	2.97	3.26	3.56	3.87	4.19	4.51	4.84	5.16	5.49	5.81	6.13	6.45
	1.69	1.80	1.92	2.05	2.18	2.34	2.51	2.70	2.91	3.16	3.43	3.71	4.01	4.31	4.62	4.93	5.25	5.56	5.88	6.20	6.51
	1.79	1.92	2.05	2.18	2.33	2.50	2.67	2.87	3.08	3.32	3.58	3.85	4.13	4.43	4.73	5.03	5.34	5.64	5.95	6.26	6.57
24	1.89	2.03	2.17	2.31	2.45	2.64	2.83	3.02	3.21	3.47	3.73	3.99	4.25	4.54	4.83	5.13	5.42	5.72	6.02	6.32	6.62

Figure 6d (1)

Global view of guidebank abutment B'/B = 0.625

1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
1.00	1.99	2.98	3.97	4.96	5.95	6.95	7.95	8.95	9.95	10.95	11.96	12.97	13.98	14.99	16.00
1.00	1.98	2.95	3.93	4.92	5.90	6.89	7.89	8.89	9.90	10.91	11.92	12.94	13.96	14.98	16.00
1.00	1.96	2.93	3.89	4.87	5.85	6.83	7.83	8.83	9.84	10.85	11.88	12.90	13.93	14.97	16.00
1.00	1.95	2.90	3.85	4.81	5.78	6.77	7.76	8.76	9.77	10.80	11.83	12.87	13.91	14.95	16.00
1.00	1.93	2.86	3.80	4.75	5.71	6.69	7.68	8.68	9.70	10.73	11.77	12.82	13.88	14.94	16.00
1.00	1.91	2.82	3.74	4.68	5.63	6.60	7.58	8.59	9.62	10.66	11.71	12.77	13.84	14.92	16.00
1.00	1.88	2.77	3.67	4.58	5.52	6.48	7.47	8.48	9.51	10.57	11.63	12.72	13.81	14.90	16.00
1.00	1.85	2.71	3.58	4.47	5.39	6.35	7.33	8.35	9.39	10.46	11.55	12.65	13.76	14.88	16.00
1.00	1.81	2.63	3.46	4.33	5.23	6.18	7.17	8.19	9.25	10.34	11.45	12.57	13.71	14.85	16.00
1.00	1.76	2.53	3.32	4.15	5.03	5.97	6.96	8.00	9.08	10.19	11.33	12.48	13.65	14.82	16.00
1.00	1.69	2.40	3.14	3.93	4.78	5.70	6.70	7.76	8.87	10.02	11.20	12.38	13.58	14.79	16.00
1.00	1.62	2.25	2.92	3.64	4.45	5.36	6.38	7.48	8.63	9.83	11.04	12.27	13.51	14.76	16.00
1.00	1.52	2.06	2.63	3.27	4.01	4.92	5.98	7.14	8.35	9.61	10.88	12.16	13.44	14.72	16.00
1.00	1.42	1.84	2.29	2.78	3.42	4.34	5.47	6.73	8.04	9.37	10.71	12.04	13.36	14.68	16.00
1.00	1.31	1.60	1.89	2.17	2.53	3.53	4.85	6.27	7.71	9.13	10.54	11.92	13.29	14.65	16.00
1.00	1.20	1.38	1.50	1.47	1.00	2.41	4.12	5.80	7.39	8.92	10.39	11.82	13.23	14.62	16.00
1.00	1.11	1.21	1.25	1.20	1.00	1.00	3.44	5.40	7.14	8.75	10.28	11.75	13.19	14.60	16.00
1.00	1.05	1.09	1.10	1.08	1.00	1.00	3.23	5.22	7.02	8.67	10.22	11.71	13.16	14.59	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.25	5.24	7.03	8.68	10.23	11.72	13.17	14.59	16.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	3.52	5.48	7.20	8.79	10.31	11.77	13.20	14.60	16.00
1.00	1.16	1.34	1.54	1.80	2.19	2.87	4.36	5.94	7.49	8.98	10.43	11.85	13.25	14.63	16.00
1.00	1.32	1.65	2.03	2.48	3.08	3.92	5.10	6.44	7.82	9.21	10.59	11.96	13.31	14.66	16.00
1.00	1.45	1.92	2.43	3.03	3.74	4.62	5.69	6.89	8.16	9.46	10.77	12.08	13.39	14.69	16.00
1.00	1.56	2.14	2.76	3.45	4.23	5.13	6.15	7.28	8.46	9.69	10.94	12.20	13.46	14.73	16.00
1.00	1.65	2.31	3.02	3.77	4.60	5.52	6.52	7.60	8.73	9.90	11.10	12.31	13.54	14.77	16.00
1.00	1.72	2.46	3.22	4.03	4.89	5.82	6.81	7.86	8.95	10.09	11.24	12.42	13.61	14.80	16.00
1.00	1.78	2.57	3.38	4.23	5.12	6.06	7.04	8.07	9.14	10.25	11.37	12.51	13.67	14.83	16.00
1.00	1.82	2.66	3.51	4.39	5.30	6.24	7.23	8.25	9.30	10.38	11.48	12.60	13.73	14.86	16.00
1.00	1.86	2.73	3.61	4.51	5.44	6.39	7.38	8.39	9.43	10.49	11.57	12.67	13.77	14.88	16.00
1.00	1.89	2.78	3.69	4.61	5.55	6.52	7.50	8.51	9.54	10.59	11.65	12.73	13.81	14.91	16.00
1.00	1.91	2.83	3.75	4.69	5.64	6.61	7.60	8.61	9.63	10.67	11.72	12.78	13.85	14.92	16.00
1.00	1.93	2.86	3.81	4.76	5.72	6.69	7.68	8.69	9.70	10.73	11.77	12.82	13.88	14.94	16.00
1.00	1.95	2.89	3.85	4.81	5.78	6.76	7.75	8.75	9.77	10.79	11.82	12.86	13.90	14.95	16.00
1.00	1.96	2.92	3.88	4.85	5.83	6.81	7.81	8.81	9.82	10.84	11.86	12.89	13.92	14.96	16.00
1.00	1.97	2.94	3.91	4.89	5.87	6.86	7.85	8.86	9.86	10.88	11.89	12.92	13.94	14.97	16.00
1.00	1.98	2.96	3.94	4.92	5.91	6.90	7.90	8.90	9.90	10.91	11.92	12.94	13.96	14.98	16.00
1.00	1.99	2.97	3.96	4.95	5.94	6.94	7.93	8.93	9.94	10.94	11.95	12.96	13.97	14.99	16.00
1.00	1.99	2.99	3.98	4.98	5.97	6.97	7.97	8.97	9.97	10.97	11.98	12.98	13.99	14.99	16.00
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00

Figure 8d (2)

Expanded view of guidebank abutment B'/B = 0.625 [scale 4:1]

	E				F				G				H				I				J
17	2.17	2.26	2.35	2.44	2.53	2.78	3.03	3.28	3.53	3.86	4.19	4.52	4.85	5.21	5.56	5.92	6.27	6.63	6.99	7.35	7.71
	1.99	2.08	2.16	2.26	2.39	2.59	2.83	3.08	3.36	3.68	4.01	4.35	4.69	5.05	5.42	5.79	6.15	6.52	6.89	7.26	7.63
	1.82	1.89	1.97	2.06	2.18	2.37	2.60	2.87	3.16	3.48	3.82	4.16	4.52	4.90	5.27	5.65	6.03	6.42	6.80	7.17	7.55
	1.64	1.71	1.76	1.82	1.92	2.10	2.34	2.62	2.93	3.26	3.61	3.97	4.34	4.73	5.13	5.52	5.92	6.31	6.70	7.09	7.47
18	1.47	1.53	1.56	1.55	1.56	1.77	2.04	2.35	2.68	3.03	3.40	3.77	4.12	4.56	4.98	5.39	5.80	6.20	6.61	7.00	7.39
	1.40	1.40	1.37	1.27	1.00	1.37	1.70	2.05	2.41	2.79	3.18	3.58	3.99	4.42	4.85	5.27	5.69	6.11	6.52	6.93	7.33
	1.33	1.31	1.26	1.17	1.00	1.00	1.36	1.73	2.12	2.54	2.96	3.39	3.82	4.27	4.72	5.16	5.59	6.02	6.44	6.85	7.26
	1.26	1.24	1.20	1.13	1.05	1.00	1.00	1.38	1.81	2.27	2.74	3.20	3.65	4.12	4.59	5.05	5.49	5.93	6.36	6.79	7.20
19	1.20	1.18	1.15	1.11	1.06	1.02	1.00	1.00	1.45	2.00	2.53	3.01	3.44	3.99	4.48	4.95	5.40	5.86	6.30	6.73	7.14
	1.17	1.15	1.12	1.09	1.06	1.03	1.01	1.00	1.00	1.75	2.35	2.89	3.39	3.90	4.40	4.88	5.34	5.80	6.24	6.68	7.11
	1.14	1.12	1.10	1.08	1.05	1.03	1.01	1.00	1.00	1.65	2.25	2.80	3.32	3.84	4.34	4.82	5.29	5.75	6.20	6.64	7.08
	1.11	1.09	1.08	1.06	1.04	1.03	1.01	1.00	1.00	1.60	2.18	2.74	3.27	3.79	4.29	4.78	5.25	5.72	6.17	6.61	7.05
20	1.08	1.07	1.06	1.05	1.04	1.02	1.01	1.00	1.00	1.58	2.15	2.70	3.23	3.75	4.26	4.75	5.22	5.69	6.14	6.59	7.02
	1.06	1.05	1.04	1.04	1.03	1.02	1.01	1.00	1.00	1.57	2.13	2.68	3.21	3.73	4.24	4.73	5.21	5.68	6.13	6.58	7.01
	1.04	1.03	1.03	1.02	1.02	1.01	1.01	1.00	1.00	1.57	2.13	2.68	3.21	3.73	4.24	4.73	5.21	5.68	6.13	6.58	7.02
	1.02	1.02	1.01	1.01	1.01	1.01	1.00	1.00	1.00	1.57	2.13	2.69	3.22	3.74	4.25	4.74	5.22	5.69	6.14	6.59	7.02
21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.58	2.16	2.71	3.25	3.77	4.28	4.77	5.24	5.71	6.17	6.61	7.03
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.60	2.19	2.76	3.30	3.82	4.32	4.81	5.29	5.75	6.20	6.64	7.08
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.64	2.25	2.82	3.36	3.88	4.39	4.87	5.34	5.80	6.25	6.68	7.12
	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.72	2.35	2.92	3.44	3.96	4.46	4.94	5.40	5.86	6.30	6.73	7.16
22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.88	2.52	3.06	3.52	4.07	4.57	5.03	5.48	5.93	6.37	6.79	7.20
	1.20	1.23	1.25	1.28	1.32	1.38	1.45	1.57	1.79	2.28	2.79	3.28	3.75	4.23	4.70	5.15	5.58	6.02	6.44	6.86	7.27
	1.40	1.45	1.50	1.56	1.64	1.73	1.86	2.03	2.29	2.67	3.09	3.52	3.96	4.40	4.84	5.27	5.70	6.12	6.53	6.94	7.34
	1.60	1.67	1.74	1.83	1.93	2.05	2.21	2.42	2.68	3.01	3.38	3.77	4.17	4.58	5.00	5.41	5.82	6.22	6.62	7.02	7.41
23	1.80	1.88	1.97	2.07	2.19	2.35	2.53	2.74	3.00	3.30	3.64	4.00	4.36	4.76	5.15	5.55	5.94	6.33	6.72	7.11	7.49
	1.97	2.08	2.19	2.31	2.45	2.62	2.81	3.03	3.28	3.57	3.88	4.22	4.57	4.94	5.31	5.69	6.07	6.44	6.82	7.20	7.57
	2.14	2.27	2.40	2.53	2.69	2.86	3.06	3.28	3.53	3.81	4.11	4.43	4.76	5.11	5.47	5.83	6.19	6.56	6.93	7.29	7.66
	2.31	2.45	2.59	2.74	2.90	3.08	3.29	3.50	3.74	4.02	4.31	4.62	4.94	5.28	5.62	5.97	6.32	6.67	7.03	7.38	7.74
24	2.48	2.63	2.78	2.93	3.08	3.29	3.50	3.71	3.92	4.21	4.51	4.81	5.10	5.44	5.77	6.10	6.44	6.79	7.13	7.48	7.82

APPENDIX E

CASE STUDIES

CASE STUDY 1: CHATANIKA BRIDGE ABUTMENT

This case study focused on the bridge at approximately mile 50 of the Steese Highway. Upstream from the bridge, a bend in the river is causing an increased amount of scour at the left abutment. Scour is further increased due to the uneven distribution of the flow of water across the bridge opening. Most of the water is concentrated between the left pier and left abutment. This study focused only on the left abutment, since the right was not experiencing significant levels of scour. The purpose of the case study was to model the bridge abutment and calculate a dimensionless depth of scour using computer solutions and laboratory experiments.

Computer Model

Three computer models were created, due to the complex nature of determining the boundary conditions of the pier. The models were generated using an iterative solution of Laplace's equation. Due to printing constraints, the horizontal scaling factor was 1 to 1000.

Constant streamline values were assigned to the boundary conditions, shear boundaries and eddies. The site and location of each structure was determined from observations of the prototype and laboratory experiment. Once the boundary conditions and eddy regions were specified, an initial computer model was solved using the aforementioned process. The results from this model were used to incorporate the left pier into the three models. From field observations and the initial computer model, three boundary condition values were chosen for the pier: 7.00, 8.82, and 10.00. Each model illustrated was evaluated and the predictions of scour were compared to the prototype.

Results:

In each computer model, the expression b/b_o -1 was evaluated at the upstream corner of the abutment. The results are listed below in Tables A1-A3. The values obtained were compared to observations of the bridge site to determine the accuracy of the solution.

The results of the first computer model, pier value 7.00, are listed below in Table A1. Scour was predicted throughout the evaluated area with the larges values occurring between streamlines 1 and 3. The smallest amount to scour, 0.91, was between streamlines 8 and 10.

Table A1: Computer model results with pier value at 7.00

From Streamline	To Streamline	b (mm)	b_o (mm)	b/b_o-1
1	3	8	12	0.5
3	5	10.5	12	0.143
5	8	16	18	0.125
8	10	11	12	0.091
10	12	10	12	0.2
12	14	10.5	12	0.143

In the second computer trial, Table A2, the value of the pier was 8.82. Generally, this produced a model with decreasing values of scour as the analysis approached the center of the stream. Between streamlines 7 through 9 and 9 through 11, negative values of scour were produced. This indicated the presence of a depositional environment between the streamlines.

Table A2: Computer model results with pier value at 8.82

From Streamline	To Streamline	b (mm)	b_o (mm)	b/b_o-1
1	3	6	12	1.0
3	5	7	12	0.714
5	7	9	12	0.333
7	9	13	12	-0.077
9	11	13	12	-0.077
11	13	12	12	0.0
13	14	6	6	0.0

For the third computer trial (see Table A3), the value of the pier was 10.00. The dimensionless expression, b/b_o-1, predicted a large depth of scour at the left bank gradually decreasing to a depositional environment at the center of the stream.

Each model predicted the highest level of scour at the left abutment and the smallest behind the pier. As the boundary condition values or the pier increased, the range between the maximum and minimum value of scour increased. This increase in range was the result of a change in the distribution of streamlines. As more streamlines traveled between the abutment and pier, the distance between the streamlines decreased. The smaller distance produced larger depths of scour. Simultaneously, fewer streamlines were between the center of the river and pier, thus producing a greater distance and smaller depths of scour.

Table A3: Computer model results with pier value at 10.00

From Streamline	To Streamline	b (mm)	b_o (mm)	b/b_o-1
1	3	5	12	1.4
3	5	7.5	12	0.6
5	7	8	12	0.5
7	9	10.5	12	0.143
9	11	14	12	-0.143
11	13	13	12	-0.077
13	14	6.5	6	-0.077

Observations of the prototype showed a large depositional environment behind the left pier. The first model did not account for this environment and thus was not representative of the prototype conditions. Both the second and third models resulted in a depositional environment behind the pier. However, the magnitude of the prediction varied between the models. Since a large depositional environment was present in the prototype, it is reasonable to assume that the third computer model best simulated the conditions present in the stream. In the future, it is likely that boundary conditions for piers may be approximated by the flow distribution of the stream. This conclusion is supported by the limited scope of the computer models used in this experiment.

Laboratory Experiment

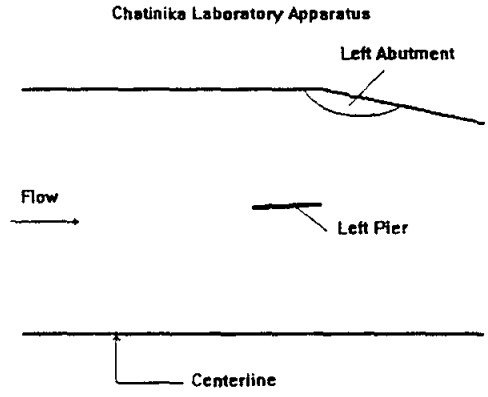
The laboratory experiments were performed in a two foot flume at the University of Alaska Fairbanks. A diagram of the general apparatus is shown below in Figure A1. The size

and shape of the model was determined using a horizontal scaling ratio of 1 to 130. The materials for the bed and bridge abutment were sand and wood respectively.

Procedure:

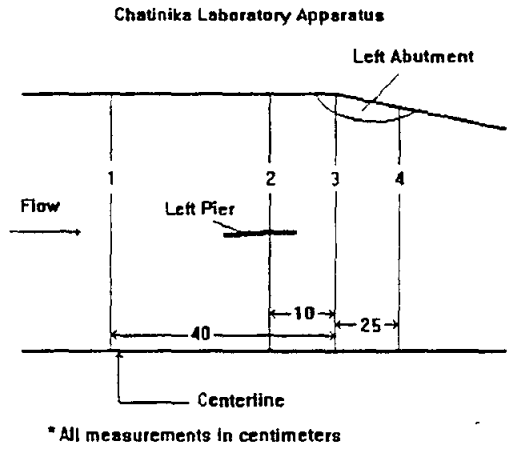
Four cross sections (their locations are shown in Figure A2) were measured to define the original height of the bed. Once the original height was recorded, the flow of water was started and raised until a live bed condition existed. At this point, the experiment was

Figure A1: Diagram of general apparatus



allowed to run until maximum scour was achieved. During this time, the velocity head and height of water was recorded. At the end of the experiment, the flow of water was stopped and each scoured cross section was measured. The data for the experiment is located in Appendix A2, Table 1.

Figure A2: Diagram of cross section measurements



Using the data obtained from the experiment, the dimensionless expression, $(Z_o-Z)/Y_o$, was evaluated and the results are shown below in Table A4. Generally, the larger values of the expression were produced by the right bank. At approximately five centimeters, the values for the general expression increased. This discrepancy is due to the influence of the pier.

Table A4: Laboratory Results of Abutment Scour

Point of Measure (cm)	Cross Section 3		$(Z_o - Z) / y_o$
	Original Height (cm)	Scoured Height (cm)	
1.0	39.0	40.5	0.366
11.0	41.6	43.8	0.328
21.0	44.1	47.4	0.359
31.0	44.3	46.5	0.234
41.0	44.3	46.9	0.277
50.0	44.2	44.9	0.075
60.0	43.9	44.2	0.033

The maximum level of scour occurred at the abutment, while the minimum was at the center of the stream. Unlike the computer and the prototype, no negative scour values were present. This may be due to the exaggerated vertical scale required for the experiment.

According to the theoretical portion of this report, the dimensionless expressions $b_o/b-1$ and $(Z_o - Z)/y_o$ are equal. Since these expressions are equal, the results from the two experiments should show similar values at approximately the same location. Although the values at the location were not similar, both models predicted the highest depth of scour at the abutment and the lowest behind the pier. From the prototype observations, the computer model simulated the actual conditions to a higher degree of accuracy.

CASE STUDY 2: CHENA BRIDGE ABUTMENT

This case study focused on the bridge at mile 37.5 of Chena Hot Springs Road near Fairbanks, Alaska. The bridge was chosen due to problematic scour that developed from a change in the river's channel. Originally, the Chena River flowed perpendicular to the bridge with scour occuring at acceptable levels. After the flood episode, the river changed course and now parallels the bridge. This change in course has resulted in the scour and costly repairs. The purpose of the case study was to model the bridge abutments and calculate a dimensionless depth of scour using computer solutions and laboratory experiments.

Computer Model

The computer model was generated using an iterative solution of Laplace's equation. A horizontal scaling factor of 1 to 450 was used to determine the dimensions of the model. Constant streamline values were assigned to the boundary conditions, shear boundaries and eddies with the size and location of each structure determined from observations of the prototype and laboratory experiment. Once the boundary conditions and eddy regions were specified, an initial computer model was solved using the iterative process. The results from this model, displayed in Appendix B1, Model 1, were used to incorporate the pier into the model. The size of the pier was determined from observations of the laboratory model and the prototype. The numeric value of the pier was estimated by the amount of flow on either side of the prototype's pier. After the value and size of the pier were defined, the initial model was solved to obtain the final results. This solution (illustrated in Appendix B1, Model 2) created a grid of numbers in which the third,

fifth, eleventh and thirteenth streamlines were drawn. These streamlines were used to evaluate the expression b/b_o -1.

Results:

The results from the computer model are shown below in Table B1. Generally, as the streamlines approach the left bank of the computer model, the dimensionless expression b/b_o -1 increases. There was a notable exception between the 13th and the 15th streamlines. At this section, the dimensionless expression predicted a negative number. A negative number should represent areas of negative scour or depositional environment. This result is supported from field observations of the prototype. The largest value, 0.87, was produced by the increased depth of scour resulting from the pier.

Table B1. Results from Computer Model with Pier at 10.78

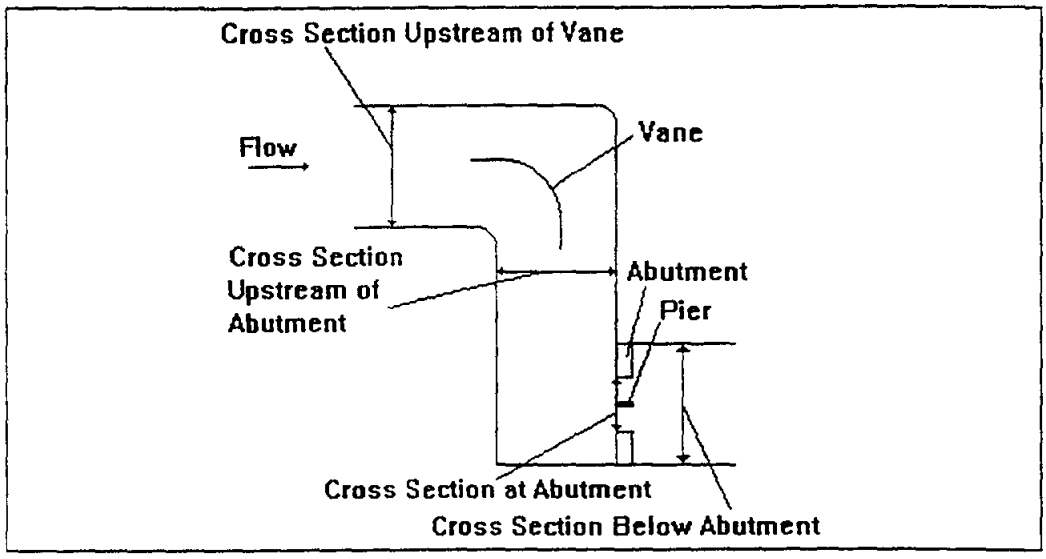
From Streamline	To Streamline	b (mm)	b_o (mm)	b/b_o-1
1	3	14	10	0.4
3	5	14	8.5	0.65
11	13	14	7.5	0.87
13	15	14	27	-0.48

Laboratory Experiment

The laboratory experiments were performed in a two foot flume at the University of Alaska, Fairbanks. A diagram of the general apparatus is shown below in Figure B1. The size and shape of the model was determined using a horizontal scaling ratio of 40 feet to 1 inch. The materials for the bed and bridge abutment were sand and wood respectively. To represent field conditions accurately, while accounting for the size constraints of the flume, a channeling vane

was used to direct the approach of the water toward the abutment (Figure B1). A Pitot tube and floating plastic beads were used to ensure that the flow was uniform throughout the channel and parallel to the road.

Figure B1. Diagram of General Laboratory Apparatus



Procedure:

Four cross sections, the locations of which are shown in Figure B1, were measured to define the original height of the bed. Once the original height was recorded, the flow of water was started and raised until a live bed existed. At this point, the experiment was allowed to run until maximum scour was achieved. During this time, the velocity head and height of water was recorded. At the end of the experiment, the flow of water was stopped and each scoured cross section was measured. The data for each experiment is located in Appendix B1, Table 1.

Using the data obtained from the experiment, the dimensionless expression, $(Z_o - Z)/y_o$, was evaluated and the results are shown below in Table B2. Generally the largest values of the

dimensionless expression were produced by the right bank. At approximately five centimeters, the values for the general expression increase. This discrepancy is due to the influence of the pier.

Table B2

Measurement from Right Abutment	Original Surface	Maximum Scour	Depth of Water	$(Z_o-Z)/y_o$
(cm)	(cm)	(cm)	(cm)	(cm)
1.00	44.8	50.7	39.2	1.05
2.00	44.9	50.7	39.2	1.02
3.00	44.9	50.2	39.2	.982
4.00	44.8	50.2	39.2	.964
5.00	44.8	50.8	39.2	1.07
6.00	45.0	50.7	39.2	.983
7.00	45.0	50.0	39.2	.862
8.00	45.1	49.5	39.2	.746

According to theoretical portion of this report, the dimesionless expressions $b_o/b-1$ and $(Z_o-Z)/y_o$ are equal. Since these expressions are equal, the results of the two experiments should show similar values at approximately the same location. Although the values at a location were not similar, both models predicted the highest depth of scour at the pier and the lowest at the left bank. From the observations of the prototype, the computer model simulated the actual conditions to a higher degree of accuracy. Due to the limited size of the flume, the accuracy of the results obtained in the laboratory experiments may have been skewed. The information obtained from this project should be helpful in the prediction of scour around these abutments.

Table A4. Laboratory Results of Abutment Scour

Point of Measure (cm)	Cross Section 3		$(Z_o-Z)/Y_o$
	Original Height (cm)	Scoured Height (cm)	
1.0	39.0	40.5	0.366
11.0	41.6	43.8	0.328
21.0	44.1	47.4	0.359
31.0	44.3	46.5	0.234
41.0	44.3	46.9	0.277
50.0	44.2	44.9	0.075
60.0	43.9	44.2	0.033

The maximum level of scour occurred at the abutment, while the minimum was at the center of the stream. Unlike the computer and the prototype, no negative scour values were present. This may be due to the exaggerated vertical scale required for the experiment.

According to the theoretical portion of this report, the dimensionless expressions $b_o/b-1$ and $(Z_o-Z)/Y_o$ are equal. Since these expressions are equal, the results from the two experiments should show similar values at approximately the same location. Although the values at a location were not similar, both models predicted the highest depth of scour at the abutment and the lowest behind the pier. From the observations of the prototype, the computer model simulated the actual conditions to a higher degree of accuracy.

Appendix A1 Model 1

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00																
2.00	2.00	1.99	1.99	1.99	1.98	1.98	1.97	1.96	1.95	1.95	1.94	1.93	1.92	1.91	1.91	1.90	1.88	1.83	1.73	1.51	1.00	1.00	1.00	1.00	1.00	1.00	1.00												
3.00	2.99	2.99	2.98	2.97	2.96	2.95	2.94	2.93	2.91	2.89	2.87	2.85	2.84	2.83	2.82	2.81	2.78	2.71	2.57	2.30	1.82	1.00	1.00	1.00	1.55	1.66	1.53	1.00	1.00	1.00	1.00								
4.00	3.99	3.98	3.97	3.96	3.95	3.93	3.91	3.89	3.87	3.84	3.81	3.78	3.75	3.74	3.73	3.74	3.73	3.67	3.54	3.31	2.98	2.57	2.43	2.41	2.54	2.57	2.46	2.23	2.10	1.96	1.69	1.00	1.00	1.00	1.00				
5.00	4.99	4.98	4.97	4.95	4.93	4.91	4.89	4.86	4.83	4.79	4.74	4.70	4.66	4.63	4.64	4.68	4.73	4.70	4.61	4.43	4.15	3.89	3.73	3.65	3.65	3.61	3.51	3.36	3.21	3.04	2.79	2.46	2.28	2.11	1.80	1.00	1.00	1.00	1.00
6.00	5.99	5.97	5.96	5.94	5.92	5.90	5.87	5.83	5.79	5.74	5.68	5.61	5.55	5.50	5.51	5.61	5.79	5.81	5.76	5.63	5.34	5.10	4.94	4.84	4.78	4.71	4.61	4.49	4.35	4.19	3.98	3.76	3.56	3.35	3.08	2.72	2.57	2.50	2.44
7.00	6.99	6.97	6.96	6.94	6.92	6.89	6.86	6.82	6.76	6.70	6.62	6.53	6.42	6.32	6.28	6.47	7.00	7.00	7.00	7.00	6.48	6.24	6.09	5.99	5.91	5.84	5.75	5.64	5.51	5.37	5.21	5.03	4.85	4.66	4.45	4.23	4.08	3.97	3.89
8.00	7.99	7.97	7.96	7.94	7.92	7.89	7.85	7.81	7.75	7.68	7.58	7.45	7.28	7.06	6.84	7.00	7.00	7.00	7.00	7.38	7.35	7.27	7.19	7.11	7.05	6.98	6.90	6.80	6.70	6.58	6.44	6.29	6.14	5.99	5.82	5.66	5.53	5.43	5.33
9.00	8.99	8.97	8.96	8.94	8.92	8.89	8.86	8.81	8.75	8.68	8.57	8.42	8.20	7.82	7.00	7.00	7.00	7.00	7.78	8.16	8.29	8.30	8.28	8.23	8.18	8.12	8.06	7.98	7.90	7.80	7.69	7.57	7.45	7.32	7.19	7.07	6.96	6.87	6.78
10.00	9.99	9.98	9.96	9.95	9.93	9.90	9.87	9.83	9.77	9.70	9.60	9.47	9.27	9.00	8.66	8.55	8.55	8.64	8.96	9.20	9.33	9.38	9.38	9.36	9.33	9.29	9.23	9.17	9.10	9.03	8.94	8.85	8.75	8.66	8.56	8.46	8.38	8.30	8.22
11.00	10.99	10.98	10.97	10.96	10.94	10.92	10.89	10.86	10.81	10.75	10.67	10.58	10.43	10.26	10.08	10.00	9.99	10.06	10.21	10.35	10.45	10.50	10.51	10.51	10.49	10.46	10.42	10.37	10.32	10.26	10.20	10.19	10.06	9.99	9.92	9.85	9.79	9.73	9.67
12.00	11.99	11.99	11.98	11.97	11.96	11.94	11.92	11.90	11.87	11.82	11.77	11.70	11.61	11.51	11.42	11.37	11.37	11.40	11.48	11.56	11.61	11.65	11.66	11.66	11.65	11.63	11.61	11.58	11.54	11.51	11.47	11.42	11.38	11.33	11.28	11.24	11.19	11.15	11.11
13.00	13.00	12.99	12.99	12.98	12.98	12.97	12.96	12.95	12.93	12.91	12.88	12.85	12.80	12.76	12.72	12.70	12.69	12.71	12.74	12.77	12.80	12.82	12.83	12.83	12.82	12.81	12.80	12.79	12.77	12.75	12.73	12.71	12.69	12.66	12.64	12.62	12.60	12.58	12.56
14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00

Appendix A1 Model 2

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00																	
2.00	2.00	2.00	2.00	2.00	2.01	2.01	2.01	2.02	2.02	2.03	2.04	2.05	2.07	2.08	2.10	2.11	2.10	2.04	1.91	1.64	1.00	1.00	1.00	1.00	1.00	1.00	1.00													
3.00	3.00	3.00	3.01	3.01	3.01	3.02	3.02	3.03	3.04	3.06	3.08	3.10	3.13	3.17	3.21	3.24	3.23	3.18	2.98	2.63	2.01	1.00	1.00	1.00	1.60	1.71	1.56	1.00	1.00	1.00	1.00									
4.00	4.00	4.01	4.01	4.01	4.02	4.02	4.03	4.04	4.06	4.08	4.11	4.14	4.19	4.26	4.33	4.40	4.44	4.38	4.21	3.89	3.40	2.86	2.63	2.56	2.67	2.67	2.54	2.28	2.13	1.98	1.70	1.00	1.00	1.00	1.00					
5.00	5.00	5.01	5.01	5.01	5.02	5.02	5.04	5.06	5.07	5.09	5.13	5.17	5.24	5.33	5.46	5.60	5.73	5.73	5.59	5.31	4.86	4.41	4.11	3.94	3.86	3.77	3.63	3.45	3.28	3.08	2.82	2.48	2.29	2.11	1.80	1.00	1.00	1.00	1.00
6.00	6.00	6.01	6.01	6.02	6.02	6.03	6.04	6.05	6.07	6.10	6.13	6.18	6.26	6.37	6.56	6.83	7.15	7.21	7.18	6.89	6.31	5.81	5.46	5.23	5.07	4.93	4.78	4.61	4.44	4.25	4.03	3.79	3.58	3.38	3.09	2.72	2.58	2.50	2.44
7.00	7.00	7.01	7.01	7.02	7.02	7.03	7.04	7.05	7.07	7.09	7.12	7.17	7.24	7.35	7.57	8.01	8.82	8.82	8.82	8.02	7.67	7.07	6.70	6.44	6.25	6.09	5.93	5.78	5.62	5.45	5.26	5.06	4.87	4.68	4.46	4.23	4.08	3.97	3.89
8.00	8.00	8.01	8.01	8.02	8.02	8.03	8.04	8.05	8.06	8.08	8.10	8.13	8.17	8.23	8.36	8.62	8.82	8.82	8.82	8.88	8.48	8.11	7.81	7.58	7.40	7.24	7.10	6.95	6.81	6.66	6.50	6.34	6.17	6.01	5.84	5.67	5.54	5.43	5.33
9.00	9.00	9.01	9.01	9.01	9.02	9.03	9.03	9.04	9.05	9.06	9.07	9.08	9.08	9.03	8.82	8.82	8.82	8.82	9.29	9.41	9.27	9.06	8.86	8.68	8.52	8.38	8.25	8.13	8.00	7.88	7.75	7.61	7.48	7.34	7.21	7.08	6.97	6.87	6.78
10.00	10.00	10.01	10.01	10.01	10.02	10.02	10.03	10.03	10.04	10.05	10.05	10.05	10.03	9.99	9.92	9.90	9.91	9.96	10.13	10.19	10.13	10.02	9.88	9.75	9.63	9.51	9.41	9.30	9.20	9.10	9.00	8.89	8.78	8.68	8.57	8.47	8.38	8.30	8.22
11.00	11.00	11.00	11.01	11.01	11.01	11.02	11.02	11.02	11.03	11.03	11.03	11.03	11.01	10.99	10.96	10.95	10.96	11.00	11.06	11.09	11.06	10.99	10.90	10.81	10.72	10.64	10.56	10.48	10.40	10.32	10.25	10.17	10.09	10.01	9.93	9.86	9.79	9.73	9.67
12.00	12.00	12.00	12.00	12.01	12.01	12.01	12.01	12.02	12.02	12.02	12.02	12.01	12.01	11.99	11.98	11.97	11.98	12.00	12.03	12.04	12.02	11.98	11.93	11.87	11.82	11.76	11.71	11.65	11.60	11.55	11.50	11.45	11.39	11.34	11.29	11.24	11.20	11.15	11.11
13.00	13.00	13.00	13.00	13.00	13.00	13.01	13.01	13.01	13.01	13.01	13.01	13.01	13.00	13.00	12.99	12.99	12.99	13.00	13.01	13.01	13.01	12.99	12.98	12.94	12.91	12.88	12.85	12.83	12.80	12.77	12.75	12.72	12.70	12.67	12.65	12.62	12.60	12.58	12.56
14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00

Appendix A1 Model 3

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00																
2.00	2.00	2.01	2.01	2.02	2.02	2.03	2.04	2.05	2.07	2.08	2.11	2.13	2.16	2.20	2.23	2.25	2.24	2.18	2.04	1.72	1.00	1.00	1.00	1.00	1.00	1.00	1.00												
3.00	3.01	3.01	3.02	3.03	3.04	3.06	3.09	3.10	3.13	3.16	3.21	3.26	3.32	3.40	3.46	3.52	3.52	3.45	3.24	2.84	2.13	1.00	1.00	1.00	1.62	1.74	1.58	1.00	1.00	1.00	1.00								
4.00	4.01	4.02	4.03	4.05	4.06	4.08	4.11	4.14	4.18	4.23	4.30	4.38	4.48	4.59	4.72	4.83	4.90	4.84	4.65	4.26	3.69	3.05	2.77	2.68	2.76	2.74	2.59	2.31	2.16	1.99	1.71	1.00	1.00	1.00	1.00				
5.00	5.01	5.03	5.04	5.06	5.09	5.10	5.14	5.18	5.23	5.29	5.37	5.48	5.62	5.78	5.99	6.20	6.38	6.39	6.23	5.88	5.91	4.75	4.36	4.13	4.01	3.88	3.72	3.51	3.32	3.11	2.84	2.49	2.30	2.12	1.80	1.00	1.00	1.00	1.00
6.00	6.01	6.03	6.05	6.06	6.09	6.12	6.15	6.20	6.26	6.33	6.43	6.55	6.72	6.94	7.24	7.62	8.03	8.11	8.01	7.71	6.93	6.28	5.80	5.48	5.25	5.07	4.88	4.69	4.50	4.29	4.06	3.81	3.59	3.37	3.09	2.73	2.58	2.50	2.44
7.00	7.01	7.03	7.05	7.07	7.09	7.12	7.16	7.21	7.27	7.35	7.45	7.59	7.77	8.02	8.40	9.01	10.00	10.00	10.00	10.00	8.44	7.61	7.09	6.73	6.46	6.25	6.06	5.87	5.69	5.50	5.30	5.09	4.89	4.69	4.47	4.24	4.08	3.98	3.89
8.00	8.01	8.03	8.05	8.07	8.09	8.12	8.16	8.21	8.27	8.34	8.44	8.57	8.74	8.98	9.35	10.00	10.00	10.00	10.00	9.86	9.22	8.65	8.22	7.88	7.63	7.41	7.22	7.05	6.88	6.71	6.54	6.37	6.20	6.02	5.85	5.68	5.54	5.43	5.33
9.00	9.01	9.03	9.04	9.06	9.09	9.12	9.15	9.19	9.25	9.32	9.40	9.51	9.65	9.82	10.00	10.00	10.00	10.00	10.28	10.22	9.91	9.58	9.24	8.97	8.74	8.55	8.38	8.22	8.08	7.93	7.79	7.64	7.50	7.36	7.22	7.09	6.97	6.87	6.78
10.00	10.01	10.03	10.04	10.06	10.08	10.10	10.13	10.17	10.21	10.27	10.34	10.43	10.53	10.64	10.73	10.77	10.79	10.82	10.88	10.83	10.66	10.43	10.21	10.00	9.82	9.66	9.52	9.39	9.27	9.15	9.03	8.92	8.80	8.69	8.58	8.48	8.39	8.30	8.22
11.00	11.01	11.02	11.03	11.05	11.06	11.08	11.10	11.13	11.17	11.21	11.27	11.33	11.40	11.47	11.53	11.56	11.58	11.60	11.61	11.56	11.45	11.31	11.16	11.01	10.88	10.76	10.65	10.55	10.46	10.36	10.28	10.19	10.11	10.02	9.94	9.87	9.80	9.73	9.67
12.00	12.01	12.01	12.02	12.03	12.04	12.06	12.07	12.09	12.12	12.15	12.18	12.22	12.26	12.31	12.34	12.37	12.38	12.39	12.38	12.35	12.29	12.20	12.11	12.01	11.93	11.85	11.77	11.70	11.64	11.58	11.52	11.46	11.40	11.35	11.30	11.25	11.20	11.15	11.11
13.00	13.00	13.01	13.01	13.02	13.02	13.03	13.04	13.05	13.06	13.07	13.09	13.11	13.13	13.15	13.17	13.18	13.19	13.19	13.19	13.17	13.14	13.10	13.05	13.01	12.96	12.92	12.89	12.85	12.82	12.79	12.76	12.73	12.70	12.68	12.65	12.62	12.60	12.58	12.56
14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00

Experiment 3

Experiment 3 focussed on the Chatinika laboratory model

Technicians Names		jsh gws		Date	8/9/94	Experiment #chatinika 3		
Material	Material	Experiment	Datum	Datum	Datum to	Velocity	Manometer	
In Bed	for Abutment	Number	to Water	to Scour	Surface o	Head	Left Leg	Right Leg
sand	gravel	Chatinika 3	34.9	------	------	1.2	-1.5	9.8

Point of	Cross Section 1		Cross Section 2		Cross Section 3		Cross Section 4	
Measure	Original	Scoured	Original	Scoured	Original	Scoured	Original	Scoured
(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)	(cm)
0.0	44.0	43.5	43.8	43.9	43.9	44.2	44.3	45.6
2.5								
5.0						44.8		
7.5								
10.0	43.5	43.7	43.7	44.5	44.2	44.9	44.0	44.6
12.5				45.2				
15.0				46.7		45.3		
17.5				47.9				
19.0	43.5	43.4	43.7	48.7	44.3	46.9	44.2	44.7
21.5								
24.0			43.5	48.0		45.6		44.9
26.5				48.4				
29.0	43.5	43.2		47.2	44.3	46.5	44.3	48.3
31.5				45.8				
34.0			43.9	44.4		45.8		48.6
36.5				45.0				
39.0	43.5	43.4		44.0	44.1	47.4	44.0	47.5
41.5				44.5	46.3	47.8		
44.0			43.9	46.3		43.7		44.0
46.5				46.5	44.2			
49.0	43.8	43.5		46.2	41.6	43.8	43.5	43.5
51.5								
54.0			44.1	44.2	39.5	42.0		
56.5								
59.0	44.0	43.9	44.2	44.2	39.0	40.5		

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.35	1.54	1.65	1.73	1.79	1.83	1.87	1.90	1.92	1.93	1.95	1.96	1.97	1.97	1.98	1.99	1.99	1.99	2.00	2.00	
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.49	1.88	2.15	2.34	2.49	2.59	2.68	2.74	2.80	2.84	2.87	2.90	2.92	2.94	2.95	2.96	2.97	2.98	2.99	2.99	3.00	
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.60	2.10	2.51	2.83	3.08	3.27	3.42	3.54	3.64	3.71	3.77	3.82	3.85	3.88	3.91	3.93	3.95	3.96	3.97	3.98	3.99	4.00	
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.68	2.29	2.80	3.24	3.59	3.88	4.10	4.28	4.43	4.54	4.64	4.71	4.77	4.82	4.85	4.89	4.91	4.93	4.95	4.96	4.98	4.99	5.00		
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.76	2.45	3.06	3.59	4.04	4.42	4.73	4.98	5.18	5.35	5.48	5.58	5.67	5.73	5.79	5.83	5.87	5.90	5.92	5.94	5.96	5.97	5.99	6.00		
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.83	2.59	3.29	3.91	4.46	4.92	5.31	5.64	5.90	6.12	6.29	6.44	6.55	6.64	6.71	6.77	6.82	6.86	6.89	6.91	6.94	6.96	6.97	6.99	7.00		
1.00	1.00	1.00	1.00	1.00	1.00	1.87	2.71	3.49	4.21	4.85	5.40	5.88	6.28	6.61	6.88	7.10	7.28	7.42	7.54	7.63	7.71	7.77	7.81	7.85	7.89	7.91	7.93	7.95	7.97	7.99	8.00		
1.00	1.00	1.00	1.00	1.00	1.90	2.79	3.65	4.46	5.20	5.86	6.43	6.91	7.31	7.64	7.90	8.12	8.29	8.44	8.55	8.64	8.71	8.77	8.82	8.86	8.89	8.91	8.94	8.96	8.97	8.99	9.00		
1.00	1.00	1.00	1.00	1.00	1.88	2.89	3.72	4.63	5.50	6.28	6.97	7.54	8.02	8.41	8.73	8.98	9.18	9.35	9.48	9.58	9.67	9.73	9.79	9.83	9.87	9.90	9.92	9.94	9.96	9.97	9.99	10.00	
1.00	1.00	1.00	1.00	1.83	2.73	3.69	4.68	5.67	6.61	7.46	8.18	8.76	9.22	9.59	9.88	10.10	10.29	10.43	10.55	10.64	10.71	10.77	10.82	10.85	10.89	10.91	10.93	10.95	10.96	10.98	10.99	11.00	
1.00	1.00	1.00	1.72	2.57	3.53	4.56	5.64	6.74	7.81	8.77	9.53	10.10	10.52	10.84	11.09	11.28	11.43	11.54	11.64	11.71	11.77	11.82	11.85	11.88	11.91	11.93	11.95	11.96	11.97	11.98	11.99	12.00	
1.00	1.00	1.53	2.30	3.22	4.25	5.37	6.58	7.85	9.13	10.29	11.06	11.57	11.92	12.17	12.35	12.49	12.60	12.68	12.75	12.80	12.84	12.87	12.90	12.92	12.94	12.95	12.96	12.97	12.98	12.99	12.99	13.00	
1.00	1.00	1.81	2.73	3.75	4.87	6.11	7.46	8.95	10.57	12.18	12.86	13.22	13.43	13.57	13.66	13.74	13.79	13.84	13.87	13.90	13.92	13.93	13.95	13.96	13.97	13.97	13.98	13.99	13.99	13.99	14.00	14.00	
1.00	1.00	2.00	3.05	4.17	5.39	6.72	8.21	9.92	12.01	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	
1.00	1.00	2.14	3.30	4.51	5.79	7.19	8.74	10.90	12.57	15.00	15.00	15.00	15.00	15.00																			
1.00	1.00	2.27	3.50	4.76	6.08	7.49	9.04	10.78	12.76	15.00	15.00	15.00	15.00	15.00																			
1.00	1.00	2.42	3.69	4.96	6.27	7.66	9.17	10.82	12.70	15.00	15.00	15.00	15.00	15.00																			
1.00	1.65	2.71	3.88	5.10	6.38	7.72	9.14	10.64	12.23	13.82	15.00	15.00	15.00	15.00																			
1.00	1.88	2.91	4.02	5.20	6.42	7.70	9.02	10.38	11.75	13.05	14.14	15.00	15.00	15.00																			
1.00	1.98	3.01	4.10	5.24	6.42	7.63	8.87	10.11	11.34	12.49	13.50	14.34	15.00	15.00																			
1.00	2.02	3.06	4.13	5.24	6.38	7.53	8.70	9.87	11.00	12.07	13.04	13.88	14.55	15.00																			
1.00	2.03	3.07	4.13	5.22	6.32	7.43	8.54	9.65	10.73	11.75	12.71	13.57	14.33	15.00																			
1.00	2.03	3.07	4.11	5.17	6.24	7.32	8.39	9.46	10.50	11.51	12.47	13.36	14.20	15.00																			
1.00	2.02	3.05	4.08	5.12	6.16	7.21	8.28	9.29	10.32	11.31	12.28	13.22	14.12	15.00																			
1.00	2.01	3.03	4.04	5.06	6.08	7.10	8.13	9.14	10.15	11.15	12.13	13.10	14.05	15.00																			
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00																			

Appendix B1 Model 2

1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.36	1.54	1.66	1.74	1.80	1.84	1.87	1.90	1.92	1.94	1.95	1.96	1.97	1.98	1.98	1.99	1.99	1.99	2.00	2.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.50	1.89	2.16	2.35	2.50	2.61	2.69	2.75	2.80	2.84	2.88	2.90	2.92	2.94	2.95	2.96	2.97	2.98	2.99	2.99	3.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.61	2.12	2.53	2.86	3.10	3.29	3.44	3.56	3.65	3.72	3.78	3.82	3.86	3.89	3.91	3.93	3.95	3.96	3.97	3.98	3.99	4.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.70	2.32	2.84	3.27	3.62	3.91	4.13	4.31	4.45	4.56	4.65	4.72	4.78	4.82	4.86	4.89	4.91	4.93	4.95	4.97	4.98	4.99	5.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.79	2.49	3.11	3.64	4.09	4.46	4.77	5.01	5.21	5.37	5.50	5.60	5.68	5.74	5.80	5.84	5.87	5.90	5.92	5.94	5.96	5.97	5.99	6.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.87	2.66	3.37	3.99	4.53	4.99	5.37	5.69	5.94	6.15	6.32	6.46	6.57	6.65	6.72	6.78	6.83	6.86	6.89	6.92	6.94	6.96	6.97	6.99	7.00
1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.95	2.82	3.62	4.33	4.96	5.50	5.96	6.35	6.66	6.92	7.14	7.31	7.44	7.56	7.64	7.72	7.77	7.82	7.86	7.89	7.92	7.94	7.96	7.97	7.99	8.00
1.00	1.00	1.00	1.00	1.00	1.00	2.02	2.97	3.86	4.66	5.38	6.01	6.55	7.01	7.39	7.70	7.95	8.16	8.33	8.46	8.57	8.65	8.72	8.78	8.83	8.86	8.89	8.92	8.94	8.96	8.97	8.99	9.00
1.00	1.00	1.00	1.00	1.00	2.07	3.09	4.06	4.96	5.79	6.52	7.16	7.69	8.14	8.50	8.79	9.03	9.22	9.38	9.50	9.60	9.68	9.75	9.80	9.84	9.87	9.90	9.92	9.94	9.96	9.97	9.99	10.00
1.00	1.00	1.00	1.00	2.07	3.17	4.23	5.23	6.15	7.00	7.76	8.40	8.92	9.34	9.68	9.94	10.15	10.32	10.46	10.57	10.65	10.72	10.78	10.82	10.86	10.89	10.91	10.93	10.95	10.97	10.98	10.99	11.00
1.00	1.00	1.00	1.99	3.12	4.30	5.44	6.47	7.41	8.31	9.12	9.76	10.26	10.63	10.92	11.15	11.32	11.46	11.57	11.65	11.72	11.78	11.82	11.86	11.89	11.91	11.93	11.95	11.96	11.97	11.98	11.99	12.00
1.00	1.00	1.75	2.84	4.11	5.46	6.76	7.79	8.72	9.70	10.63	11.28	11.71	12.01	12.23	12.40	12.52	12.62	12.70	12.76	12.81	12.85	12.88	12.90	12.92	12.94	12.95	12.96	12.97	12.98	12.99	12.99	13.00
1.00	1.00	2.18	3.51	5.01	6.68	8.36	9.22	9.96	11.13	12.44	13.00	13.30	13.48	13.60	13.69	13.75	13.80	13.84	13.88	13.90	13.92	13.94	13.95	13.96	13.97	13.98	13.98	13.99	13.99	13.99	14.00	14.00
1.00	1.00	2.45	4.01	5.76	7.87	10.78	10.78	10.78	12.42	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
1.00	1.00	2.62	4.30	6.15	8.27	10.78	10.78	10.78	12.77	15.00	15.00	15.00	15.00	15.00																		
1.00	1.00	2.72	4.44	6.26	8.29	10.78	10.78	10.78	12.87	15.00	15.00	15.00	15.00	15.00																		
1.00	1.00	2.83	4.49	6.15	7.85	9.48	10.40	11.33	12.93	15.00	15.00	15.00	15.00	15.00																		
1.00	1.78	3.09	4.53	6.01	7.48	8.87	10.04	11.19	12.53	13.93	15.00	15.00	15.00	15.00																		
1.00	2.03	3.23	4.53	5.87	7.21	8.49	9.69	10.86	12.05	13.21	14.20	15.00	15.00	15.00																		
1.00	2.10	3.27	4.49	5.74	6.98	8.19	9.36	10.50	11.61	12.68	13.59	14.38	15.00	15.00																		
1.00	2.12	3.26	4.42	5.61	6.78	7.94	9.07	10.17	11.23	12.23	13.14	13.93	14.57	15.00																		
1.00	2.10	3.22	4.35	5.48	6.61	7.72	8.81	9.88	10.91	11.88	12.79	13.62	14.35	15.00																		
1.00	2.08	3.17	4.26	5.35	6.44	7.52	8.58	9.62	10.64	11.61	12.53	13.41	14.22	15.00																		
1.00	2.06	3.11	4.17	5.23	6.29	7.34	8.38	9.40	10.40	11.38	12.33	13.25	14.13	15.00																		
1.00	2.03	3.06	4.09	5.12	6.14	7.17	8.18	9.20	10.20	11.18	12.16	13.12	14.06	15.00																		
1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00																		

Experiment 5

This experiment focused on the Chena River laboratory model

Technicians Names: JSH GWS time: 12:05-12:50

Date	Exp. #	Material In Bed	Material for Abutment	Abutment Width	Abutment Thickness	Datum to Water	Datum to Scour	Datum to Surface	Velocity Head	Manometer Difference
28-Jul	5	Sand	Wood	1 inch	2 inches	39.2	50.8	44.9125	1.3 cm	0.1

Cross Section Upstream of Vane

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
Original	45.1	45.1	45.2	45.1	45	44.9	44.9	44.8	44.8
Scoured	44	44	44	44	44	43.9	43.9	44	44.1

Cross Section Upstream of Abutment

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00
Original	45	44.9	44.8	44.9	45	45	45	45	45.1
Scoured	44.5	44.8	45.1	45.3	45.2	45.7	46.1	46	45.8

Cross Section at Abutment

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00
Original	44.8	44.9	44.9	44.8	44.8	45	45	45.1
Scoured	50.7	50.7	50.5	50.2	50.8	50.7	50	49.5

Cross Section below Abutment

	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00	11.00	12.00	13.00	14.00	15.00	16.00
Original	44.8	44.8	44.7	44.6	44.5	44.6	44.7	44.8	44.8	44.7	44.8	44.8	44.7	44.8	44.9	44.9
Scoured	43.7	44.2	44	44.1	44.2	44.1	43.9	43.7	43.6	43.5	43.9	43.9	43.9	43.5	43	43.5

Measurements of length for flume model

a	b	c	d	e	f	g	h
----	40	----	15	----	4	----	10

APPENDIX F

TASK REPORT: SUMMARY REPORT ON EXISTING METHODS

ALASKA COOPERATIVE TRANSPORTATION AND PUBLIC FACILITIES RESEARCH PROGRAM (CTPRP)

Project Name:	Field and Laboratory Investigation of Bridge Abutment Scour
Project Number:	SPR-UAF-92-3
Principal Investigator:	Robert F. Carlson Professor of Civil Engineering University of Alaska Fairbanks
Technical Advisor:	Mark Miles ADOT&PF Fairbanks
DOT&PF Project Manager:	David C. Esch

PROJECT REPORT

Task Title: Summary Report on Existing Methods

Date: August 3, 1993

Introduction: This report gives the results of the task activity which was aimed at assessing the present methods of estimation of bridge abutment scour. Because the present approaches are rather limited in scope and not working well, another report will describe a research approach which we feel may improve the reliability of the design estimate for scour at bridge abutments. The two reports together represent the progress report of the first phase of the project.

Review of current practice: From conversations with ADOT&PF and FHWA hydraulic engineers, the current approach for abutment scour design relies on using the empirical equations in the FHWA publications: "Highways in the River Environment" (Richardson et al., 1988). Because these equations have been developed with laboratory data and with limited field verification, the results often appear much too conservative and are often not trusted. Adjustments are often made with the design engineer's best judgement and with consideration of local conditions.

A search of recent literature revealed over 30 articles on the general subject of bridge scour. However, nearly all are directed towards pier scour related phenomena which is only of peripheral interest to this project. The two references of interest to this project are briefly summarized below; complete citations, abstracts and copies of all of the articles are available on request.

1) Melville, B.W.. 1992. Local Scour at Bridge Abutments. Journal of Hydraulic Engineering, 118:4, April.

Mr. Melville has done much of the substantial research on bridge pier and abutment scour over the past several years. Of the 24 references listed in this paper, 13 were written on research done at Melville's program at the University of Auckland, Auckland, New Zealand. He does not reference any recent contemporary work in the U.S. other than Richardson et al. The advantage for Alaskan projects is the New Zealand streams are very similar. However, in Melville's words, "The design method presented herein is derived from laboratory flume data and has not been field tested." In summary, this paper represents the state-of-the-art for bridge abutment design.

2) Richardson, E.V., D.B. Simons and P.Y. Julian. 1988. Highways in the River Environment. Federal Highway Administration. U.S. Dept. of Transportation. Washington D.C.

The material on bridge abutment scour design is embedded in a much larger report on highway stream crossing design. The abutment scour design guidelines are presented as regression equations which in turn are based on work done at Colorado State University and elsewhere. It represents the state-of-the-art for the U.S. As already mentioned, the equations seem to give scour depth values which are much too conservative and result in an expensive design.

Summary of literature review: The two references described above represent the current practice for determining the depth of scour at bridge abutments. The relationships presented therein are based on laboratory investigations. They do not appear to scale up to field conditions in a reasonable fashion. Also, some parameters may be represented in certain specific conditions which are not covered in the ranges of laboratory values.

APPENDIX G

TASK REPORT: SUMMARY REPORT ON RESEARCH STRATEGY

ALASKA COOPERATIVE TRANSPORTATION AND PUBLIC FACILITIES RESEARCH PROGRAM (CTPRP)

Project Name:	Field and Laboratory Investigation of Bridge Abutment Scour
Project Number:	SPR-UAF-92-3
Principal Investigator:	Robert F. Carlson Professor of Civil Engineering University of Alaska Fairbanks
Technical Advisor:	Mark Miles ADOT&PF Fairbanks
DOT&PF Project Manager:	David C. Esch

PROJECT REPORT

Task Title: Summary Report on Research Strategy

Date: August 3, 1993

Introduction: This report discusses a research plan which is intended to improve the reliability of prediction and design for bridge abutment scour. A companion progress report assesses the current state-of-the-art. The two reports together represent the progress report of the first phase of the project.

Some possible research approaches: The current literature and conversations with hydraulic engineers reveal that, although a great amount of laboratory research has been completed, there is a considerable lack of confidence in applying the results to field design situations. In contrast, laboratory work on bridge pier scour seems to be well established and has proved to be useful for field application. When comparing the two situations, most pier designs are in the middle of the stream and are fairly standard within a narrow range of variability while abutment designs are much more influenced by nearby channel and bank configurations.

Another frustration with the abutment design problem is that the abutment zone in many Alaskan streams may be almost unaffected by the main channel flow for many years but then may be finally subject to stream channel attack brought about by a main channel shift. As a result, field verification data may take many years to observe and acquire.

The current suite of laboratory studies appear to be very through and well done. Another set of general laboratory studies would need to be extensive and possibly investigate different ways to present the results so as to be more useful and reliable. This type of study is beyond the resources of the current project.

One promising note is the growing usefulness of hydraulic streamflow computer models which are capable of examining detailed flow situations on 486 class computer platforms. With this tool, the design engineer could reconstruct existing or expected channel configurations, impose historic or expected design flows and predict the regions around an abutment where critical scour velocities may be exceeded.

Proposed research plan: With the above considerations in mind, the following plan has been developed which should lead to a useful approach to bridge abutment design for Alaskan design engineers and within the limited resources of the present project. It uses all three tool of hydraulic analysis-laboratory modeling, computer modeling and field study. By focusing on bridge abutments which are posing some erosion stress, we will maximize the opportunity for explaining a field occurrence. Each of the three analysis approaches will lead to a more complete understanding of the abutment failure problem and, when compared to the standard prediction equations, will lead to a better understanding of abutment scour design.

1) We will select bridge abutments which appear to have undergone some erosion stress in the recent past. At this time we will use two sites near Fairbanks: the Chatinika River on the Steese Highway and the Chena River on the Chena Hot Springs Highway. Both are undergoing some abutment erosion, the Steese Highway site due to a long term channel shift and the Chena Hot Springs site due to a dramatic cutoff of an upstream meander bend. Sufficient channel information will be collected to characterize the flow regime for the laboratory and computer model studies.

2) We will reconstruct each bridge site at the appropriate laboratory scale. A set of flood flows will be simulated in the laboratory and the results of abutment scour noted. Various remediation measures can be easily examined and evaluated. The laboratory results will be compared to the field data.

3) The bridge site channel regime will be simulated with the FHWA finite element model flow model. Areas which may exceed a critical sour velocity will be noted and the consequences for excessive scour assessed. The results will be compared to the field and laboratory results.

4) The results of the three scour analysis approaches will be synthesized into a statement which will describe the occurrence of scour at each site. A comparison will be made to the existing design prediction equations. Following this phase, the design engineer will have a useful set of tools for estimating abutment sour and an indication of the degree of reliability of the estimate.