Deltares

Enabling Delta Life

Piping Doorlatendheid Rekentool

Test Report

Deltares

Piping Doorlatendheid Rekentool

Test Report

11202231-002

Deltares

Title
Piping Doorlatendheid Rekentool

Client	Project	Reference	Pages
RWS - WVL	11202231-002	11202231-002-HYE-0013	20

Classification
-

Keywords
Dike, safety assessment, design, software, piping

Summary
This document contains the test report for Piping Doorlatendheid Rekentool, an application for calculating the equivalent permeability of a two-layer system, to be used in the WBI piping kernel, which only uses one-layer. All the requirements for this tool were tested and the tests succeeded. The correct functioning of this tool is therefore ensured.

Samenvatting
Dit document bevat het testrapport voor Piping Doorlatendheid Rekentool, een applicatie die de equivalente doorlatendheid berekent voor een tweelagen systeem, om toe te passen op de WBI piping kernel, die enkel een laag toestaat. Alle requirements voor deze applicatie zijn getest en de testen waren allemaal succesvol. Het correct functioneren van de kernel is dus gegarandeerd.

References
Refer to chapter 7

Version	Date	Author	Initials	Review	Initials	Approval	Initials
1.0	Jun. 2018	Carles Salvador Soriano Perez	CSSP	Hans van Putten dr. V. Trompille		Marcel van Gent	

Status
final

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1 Introduction

1.1 Purpose and scope of this document

This document contains the test report for the Piping Doorlatendheid Rekentool, an application for calculating the equivalent permeability of a two-layer system, to be used in the WBI piping kernel, which only uses one-layer.

The document will not give any background on the context of the Piping Doorlatendheid Rekentool. For this purpose please refer to any of the documents described in section 1.2.

This Test Report describes the results of the tests that must take place before the program can be released. Said tests are based on the revision number 7432 of the 18.1.1 release of the Piping Doorlatendheid Rekentool.

All reports hereby described have been retrieved from the TeamCity build (see appendix Appendix A), which also extends the overviews presented.

1.2 Related Documents

Table 1.1: *Overview of related documents for the Piping Doorlatendheid Rekentool*

Document	Reference
Manual	(The, 2018c)
Functional Design	(The, 2018b)
Technical Design	(Soriano Pérez, 2018a)
Technical Documenation	(Doxygen, 2018)
Test Plan	(Soriano Pérez, 2018b)

1.3 Requirements

The requirements have been specified in the Functional Design document (The, 2018b). In Table 1.2 we have an overview of the requirements and the sections of this document where it is explained how they will be tested to prove their fulfillment.

Table 1.2: *Overview of requirements being met for the Piping Doorlatendheid Rekentool*

Requirement	How it is covered
Functional requirements	
Input.Parameters	section 2.1.1 and chapter 4
Validate.Input	section 2.1.1 and chapter 4
Calculate.Permeability	section 2.1.1 and chapter 4
Output.Parameters	section 2.1.1 and chapter 4
Non-functional requirements	
Language.Dutch	chapter 4
Performance.Speed	chapter 3
Code.Coverage	chapter 5

1.4 Versions

1.4.1 Version 1.0

This is the first version of the document.

2 Component and Integration Testing

The tests on code level are the unit tests. For each relevant function, a unit test is defined within the C# solution. A relevant function is a function that actually performs part of the calculation, validation or I/O of the core. Properties and purely administration functions do not have unit tests.

The tests on functional level are the integration tests. These types of tests combine multiple functions in the kernel to prove that high level functionality works. For this, a unit test is defined within the C# solution for each method with high level functionality.

2.1 Number of unit/integration tests and status

Different unit tests exist as reported in the table below. All unit/integration tests succeed.

Table 2.1: *Overview of the unit tests and integration tests for Piping Doorlatendheid Rekentool*

Class name	Number	Failed
Namespace: Deltares.PipingDoorlatendheidRekentool.app.Tests		
MainWindowTest	1	0
MainWindowViewModelTest	10	0
RelayCommandTest	3	0
Subnamespace: Converters		
DoubleToStringConverterTest	8	0
PptLogSeverityToStringConverterTest	8	0
ValidRunCheckToStringConverterTest	5	0
Subnamespace: UserControls (see section 2.1.1)		
PptParameterValidationTest	4	0
PptParameterControlTest	2	0
Subnamespace: ViewTests (see section 2.1.1)		
ViewLogMessageTest	5	0
ViewResultTest	6	0
Namespace: Deltares.PipingDoorlatendheidRekentool.Domain.Tests		
PptInterfaceTest	5	0
PptUiParameterTest	8	0
PptUiResultTest	3	0
PptUiModelTest	2	0
Total	70	0

2.1.1 Integration tests.

The tests included in the Namespaces Deltares.PipingDoorlatendheidRekentool.app.Tests and Deltares.PipingDoorlatendheidRekentool.Domain.Tests from Table 2.1 cover part of the functional requirements as can be seen in the following paragraphs.

2.1.1.0.1 Namespace: Deltares.PipingDoorlatendheidRekentool.app.Tests

Here we include all tests that emulate the interaction of the User with the tool (thanks to a MVVM architecture approach, see (Soriano Pérez, 2018a)).

2.1.1.0.1.1 UserControls

By testing the user controls we can verify whether the input validations are correctly triggered (*Input.Parameters* and *Validate.Input*, both functional requirements) if the value introduced differs from the type given, or its maximum and minimum accepted values.

2.1.1.0.1.2 ViewTests

These tests encapsulate everything related with outputting results to the user. Meaning both error handling and results will be tested to ensure they behave as expected (*Output.Parameters* functional requirement).

2.1.1.0.2 Namespace: Deltares.PipingDoorlatendheidRekentool.Domain.Tests

Through these tests we verify that the calculations can be done (*Calculate.Permeability*, functional requirement) with no unexpected behaviors (crashes or invalid results) and doing a proper **error handling** (catching the error).

These tests do not have a meaningful input, just values that should suffice to verify all possible workflows within the component. For an analysis of whether the calculation is given the accurate result we have the System tests (see chapter 3).

Also, the nature of this tests is more related to **unit tests**, verifying that we can create such objects and call to their inner functions.

3 System Testing

The system testing of the Piping Doorlatendheid Rekentool includes those tests based on the benchmarks (see section 3.1) and are all defined within the **Deltares.PipingDoorlatendheid-Rekentool.PptKernel.Tests.DomainTest** class (see section 3.2). We can divide these tests in two types as follows:

- The calculation should run in less than a second. This will be solved by running all cases in the mentioned test bench and verifying both their computation time.
- Given an input model, the end results should match the expected Equivalent Darcy Permeability.

3.1 Benchmark cases

In order to provide an accurate result of a calculation, five benchmark cases were defined in the Test Plan (Soriano Pérez, 2018b) together with their expected values for intermediate and end calculations (Table 3.2).

Table 3.1: *Benchmark (BM) input parameters for Piping Doorlatendheid Rekentool*

Parameter	BM 1	BM 2	BM 3	BM 4	BM 5
γ_w	9.81	19.62	4.905	100	9.81
$\gamma_{sub,p}$	16.5	24	13	10000	16.5
η	0.25	0.2	0.1	1	0.25
ϑ	37	42	18	72	37
d_{70}	0.0002	0.000065	0.0001	1	0.0002
d_{70m}	0.000208	0.000089	0.0000001	1	0.00065
ν_w	0.00000133	2.56×10^{-08}	1.00×10^{-06}	0.010791	0.00000133
L	50	32	3	10000	50
$D1$	10	2	1	10000	10
$D2$	10	6	1	10000	0.00001
$k1$	0.0001	2.00×10^{-03}	0.00001	10000	0.0001
$k2$	0.0001	8.00×10^{-04}	0.0001	10000	0.008
$k3$	0.0001	5.00×10^{-02}	0.00005	10000	0.005

Table 3.2: *Benchmark (BM) expected values for Piping Doorlatendheid Rekentool*

Value	BM 1	BM 2	BM 3	BM 4	BM 5
k	1.14×10^{-04}	2.46×10^{-03}	1.21×10^{-10}	$9.96\times10^{+03}$	7.38×10^{-03}

3.2 Number of system tests and status

The acceptance tests for Piping Doorlatendheid Rekentool should focus on ensuring the coupling between the kernel and the user interface. In Table 3.3 we have an overview of them.

Table 3.3: *Overview of the system and acceptance tests for Piping Doorlatendheid Rekentool*

Class name	Number	Failed
Namespace: Deltares.PipingDoorlatendheidRekentool.PptKernel.Tests.DomainTest		
PptInterfaceTest (section 3.2.1)	10	0
Total	10	0

3.2.1 PptInterfaceTest

The class PptInterfaceTest contains ten tests that can be clustered into two.

1 One system test checks that every case of the input test benchmark runs in less than 1 second (see Table 3.4).
2 The second verifies that the benchmark cases return the expected result as specified in Table 3.2.

Table 3.4: *Summary of calculation time given the benchmark input cases of Table 3.1*

Benchmark case	Calculation time
BM 1	6ms
BM 2	1ms
BM 3	1ms
BM 4	1ms
BM 5	1ms

4 Acceptance tests

The User Interface has been tested using test-scripts specified in the Test Document (The, 2018a). Moreover the output results were verified using the same benchmarks described in section 3.1.

For each new version a new report has been written, the latest one can be found in the appendix (see Appendix B). This report contains the results of **manually** testing the tool point after point of the Test Document.

All **functional requirements** mentioned in Table 1.2 are tested. From the **non-functional** we will exclude the Code Coverage requirement (see chapter 5). The test results were positive except for the following:

- Error message containing text in English (word 'Infinity').
- Pasting the result table into a text editor (for example Notepad) writes 'Error' instead of 'Fout'.
- Some parameters (d_{70} and d_{70m}) accept a minimum value of 1.0×10^{-11} instead of 1.0×10^{-05}. However, a proper error is given when the user tries to run a model with an invalid value.

5 Coverage Tests

To determine what proportion of the code is actually being tested by coded (unit) tests, the code coverage feature of Visual Studio is used. The results of this tool are displayed on the Deltares build server called TeamCity (see Appendix A).

An overview of what can be found in said build server is given in Table 5.1 showing the percentage of the code that was tested in each assembly, class, and method.

Table 5.1: *Overview of the code coverage tests for Piping Doorlatendheid Rekentool*

Type	Class	Method	Statement
Namespace: Deltares.PipingDoorlatendheidRekentool.app			
App	0% (0/1)	0% (0/1)	0% (0/1)
MainWindow	100% (1/1)	100% (2/2)	100% (4/4)
MainWindowViewModel	100% (1/1)	100% (33/33)	100% (72/72)
Subnamespace: Commands			
RelayCommand	100% (1/1)	83.3% (5/6)	86.7% (13/15)
Subnamespace: Converters			
DoubleToStringConverter	100% (1/1)	100% (2/2)	100% (12/12)
PptLogSeverityToStringConverter	100% (1/1)	100% (2/2)	100% (9/9)
ValidRunCheckToStringConverter	100% (1/1)	100% (2/2)	100% (7/7)
Subnamespace: UserControls			
PptParameterControl	100% (1/1)	100% (5/5)	100% (8/8)
PptParameterValidation	100% (1/1)	100% (2/2)	100% (14/14)
Subnamespace: View			
ViewLogMessage	100% (1/1)	100% (7/7)	94.1% (16/17)
ViewResult	100% (1/1)	100% (24/24)	100% (41/41)
Namespace: Deltares.PipingDoorlatendheidRekentool.Domain			
PptInterface	100% (1/1)	100% (5/5)	100% (21/21)
PptUiModel	100% (1/1)	100% (27/27)	100% (41/41)
PptUiParameter	100% (1/1)	100% (4/4)	100% (20/20)
PptUiResult	100% (1/1)	100% (2/2)	100% (7/7)
Total	93.3% (14/15)	98.3% (122/124)	98.6%(285/289)

As can be seen, the requirement set in the Functional Design (The, 2018b) of an 80% code coverage has been achieved.

6 Conclusion

Through the creation of Unit, Integration and System tests we can guarantee that the **functional requirements** described in the Functional Design (The, 2018b) are met. Moreover, we have also created system tests to verify that the **non-functional requirement** for speed performance is covered. On the other hand, Acceptance tests are reported based in the Test Document (The, 2018a) that can be found in Appendix B.

Finally, and as seen in Table 5.1, we have demonstrated that the **non-functional requirement** for code coverage is also fulfilled.

The number of tests performed covers all the requirement of Piping Doorlatendheid Rekentool defined in the Functional Design (The, 2018b). All tests succeed ensuring the correct functioning of this kernel.

7 Literature

Doxygen, 2018. *Piping Doorlatendheid Rekentool Technical Documentation*. Tech. rep., Deltares.

Soriano Pérez, C. S., 2018a. *Piping Doorlatendheid Rekentool Technical Design*. Tech. Rep. 11202231-002-HYE-0011, Deltares.

Soriano Pérez, C. S., 2018b. *Piping Doorlatendheid Rekentool Test Plan*. Tech. Rep. 11202231-002-HYE-0012, Deltares.

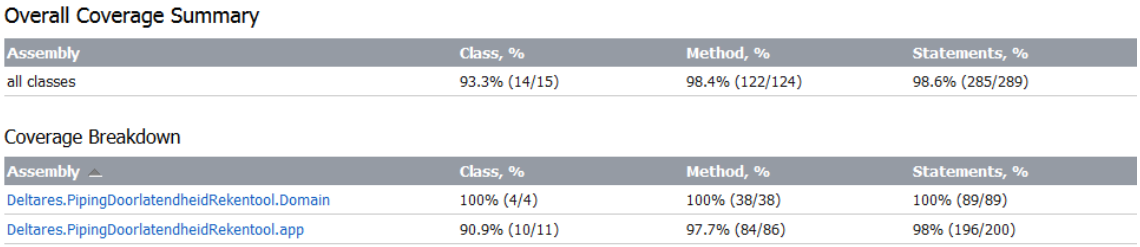
The, T., 2018a. "Piping Doorlatendheid Master Sheet Tests."

The, T., 2018b. *Piping Doorlatendheid Rekentool Functional Design*. Tech. Rep. 11202231-002-HYE-0009, Deltares.

The, T., 2018c. *Piping Doorlatendheid Rekentool Handleiding*. Tech. Rep. 11202231-002-HYE-0010, Deltares.

A TeamCity

A more detailed view of Unit, Integration and Acceptance tests can be found on the build server TeamCity which displays on detail what is doing each of their tests. On the same manner, an extensive code coverage can be found in the TeamCity project 'Code Coverage', were the code is also highlighted for both covered and uncovered pieces of code.



Overall Coverage Summary

Assembly	Class, %	Method, %	Statements, %
all classes	93.3% (14/15)	98.4% (122/124)	98.6% (285/289)

Coverage Breakdown

Assembly	Class, %	Method, %	Statements, %
Deltares.PipingDoorlatendheidRekentool.Domain	100% (4/4)	100% (38/38)	100% (89/89)
Deltares.PipingDoorlatendheidRekentool.app	90.9% (10/11)	97.7% (84/86)	98% (196/200)

Figure A.1: *TeamCity Code Coverage overview*

B Test Document

Test Document voor Piping Doorlatendheid Rekenetool versie 18.1.1.7419

Auteur: Tom The
Versie: 1.0
Datum: 16/7/2018
Gebaseerd op: 18.1.0.7381

Algemeen:

Dit document beschrijft de test procedure van het programma Piping Doorlatendheid Rekentool. De tester zal aan de hand van dit document een test uitvoeren. De test die beschreven wordt in dit document is een functionele test. De inhoudelijk test wordt door middel van verificatie sommen uitgevoerd, en wordt in een ander document beschreven.

Revisie historie:

Versie	Datum	Gebaseerd op	Door:	Aanpassingen
1.0	16/7/2018	18.1.0.7381	Tom The	Eerste versie

Algemene gegevens:

Versie:	18.1.1.7419			
Naam Tester:	-			
Datum Test:	-			
Image:	Platform: W7	Decimal:	Resolutie: 1920*1080	Kleurenschema:
Taal operating system:	Engels			
Printers:	Nee			
Opmerkingen tester: *Op een totaal van 70 tests, 2 tests slagen niet en 68 tests slagen wel.*				

Lijst van "Use cases" van het programma:	Use case getoetst d.m.v. test van REQ ...
UC.DeterminePermeability: A user wants to calculates the equivalent permeability of a two-layer system to use it in theWBI piping kernel	Input.Parameters Validate.Input Calculate.Permeability Output.Parameters

Lijst van "Functional Requirements" van het programma:	REQ getoetst in testscript(s) nummer ...
Input.Parameters	**3.01 en 5**
Validate.Input	**4 en 5**
Calculate.Permeability	**3,02**
Output.Parameters	**3,03**

Lijst van "Non-functional Requirements" van het programma:	REQ getoetst in testscript(s) nummer ...
Language.Dutch: The Piping Doorlatendheid Rekentool user interface uses the Dutch language	**3.04, 4.02 en 5.02**
Performance.Speed: The calculations itself are simple and a calculation in the Piping Doorlatendheid Rekentoolshould not take more than 1 second.	**3,02**
Code.Coverage: Code coverage of the Piping Doorlatendheid Rekentool should be at least 80%.	**N.v.t. in test document**

Nr.	Test script	Voldoet ?	Opmerkingen
1	**Piping Doorlatendheid Rekentool - Installatie**		
1.01	Installatie verificatietest	Ja	
	Unzip de installatiefile in een directory, zoals beschreven in paragraaf "2.1 Unzip" in de handleiding. Kan het programma dan opgestart worden?		
1.02	Installatie verificatietest	Ja	
	Volg de verschillende stappen van paragraaf "2.2 Verificatie installatie" van de handleiding van de Piping Doorlatendheid Rekentool		
2	**Piping Doorlatendheid Rekentool - Afsluiten**		
2.01	Kan het programma afgesloten worden		
	System menu - Close	Ja	
	Close button rechtsboven	Ja	
3	**Piping Doorlatendheid Rekentool - Invoer en rekenen en uitvoer**		
3.01	Invoer		
	Kan de invoer zoals beschreven in paragraaf 4.1 Tutorial 1 ingevoerd worden	Ja	
3.02	Rekenen		
	Kun je rekenen door op de "Rekenen" knop te drukken	Ja	
	Duurt de berekening niet langer dan 1 seconde	Ja	
3.03	Uitvoer		
	Wordt de berekening in de resultaat tabel getoond en komt de uitkomst overeen met wat beschreven is in paragraaf "4.1 Tutorial 1"	Ja	
3.04	Nederlands		
	Zijn alle teksten in invoer en uitvoer in het Nederlands?	Ja	
3.05	Kopieer naar klembord		
	Kan de tekst uit de resultaat tabel gekopieerd worden met de knop 'Kopieer naar klembord' en vervolgens geplakt in bijv. Notepad	Ja	
3.06	Log schoonmaken		
	Kan de resultaat tabel leeggemaakt worden met de knop 'Log schoonmaken'	Ja	
4	**Piping Doorlatendheid Rekentool - Validatie**		
4.01	Wordt de invoer gevalideerd?		
	Start pogramma en reken. Worden er validatiemessages getoond in het logscherm voor alle waarden die niet opgegeven zijn?	Ja	
4.02	Nederlands		
	Zijn alle teksten in de validatie in het Nederlands?	Nee	Bij foute waarden staat Infinity. Lag aan engelstalige machine?
4.03	Kopieer naar klembord		
	Kan de tekst uit de tabel gekopieerd worden met de knop 'Kopieer naar klembord' en vervolgens geplakt in bijv. Notepad	Ja	Met Error ipv Fout.
4.04	Log schoonmaken		
	Kan de tabel leeggemaakt worden met de knop 'Log schoonmaken'	Ja	
5	**Piping Doorlatendheid Rekentool - parameter grenzen**		
5.01	Controleer de volgende input parameters:		
	Algemeen		
	nat soortelijk gewicht van korrels		
	Eenheid: [kN/m3]	Ja	
	Default: 16.5	Ja	
	Valid interval * Min: 0.00001	Ja	
	Max: ∞	Ja	
	kinematische viscositeit van water		
	Eenheid: [m2/s]	Ja	
	Default: 1.33e-6	Ja	
	Valid interval Min: 1.0e-10	Ja	
	Max: 1.0	Ja	
	soortelijk gewicht van water		
	Eenheid: [kN/m3]	Ja	
	Default: 9.81	Ja	
	Valid interval Min: 0.00001	Ja	
	Max: ∞	Ja	
	coëfficiënt van White		
	Eenheid: [-]	Ja	
	Default: 0.25	Ja	
	Valid interval Min: 0.1	Ja	
	Max: 1.0	Ja	
	rolhoek		
	Eenheid: [deg]	Ja	
	Default: 37	Ja	
	Valid interval Min: 18.0	Ja	
	Max: 72.0	Ja	
	VNK		
	dike laag 1		
	Eenheid: [m]	Ja	
	Default: None	Ja	
	Valid interval Min: 0.00001	Ja	
	Max: ∞	Ja	
	dikte laag 2		
	Eenheid: [m]	Ja	
	Default: None	Ja	
	Valid interval Min: 0.00001	Ja	
	Max: ∞	Ja	
	Darcy doorlatendheid materiaal 1		
	Eenheid: [m/s]	Ja	
	Default: None	Ja	
	Valid interval Min: 0.00001	Ja	
	Max: ∞	Ja	
	Darcy doorlatendheid materiaal 2		
	Eenheid: [m/s]	Ja	
	Default: None	Ja	
	Valid interval Min: 0.00001	Ja	
	Max: ∞	Ja	

		Darcy doorlatendheid materiaal 3				
			Eenheid:	[m/s]	Ja	
			Default:	None	Ja	
		Valid interval	Min:	0.00001	Ja	
			Max:	∞	Ja	
		70%-fractie van de korrelgrootteverdeling				
			Eenheid:	[µm]	Ja	
			Default:	None	Ja	
		Valid interval	Min:	1.0e-5	Ja	Wordt nog wel min waarde 1e-11 aa
			Max:	∞	Ja	
		referentiewaarde van d 70				
			Eenheid:	[µm]	Ja	
			Default:	208	Ja	
		Valid interval	Min:	1.0e-5	Ja	Wordt nog wel min waarde 1e-11 aa
			Max:	∞	Ja	
		kwelweglengte				
			Eenheid:	[m]	Ja	
			Default:	None	Ja	
		Valid interval	Min:	0.00001	Ja	
			Max:	∞	Ja	
		Wordt bij een falende validatie het invulvak rood omlijnd en wordt een tooltip getoond?			Ja	
		Wordt bij een falende validatie een bericht getoond in het logscherm als je rekent?			Ja	
5.02	Nederlands					
	Zijn alle teksten in de validatie in het Nederlands?				Nee	Bij foute waarde staat infinity. Lag aan engelstalige machine?