Journal

of the meeting between:

See-Berufsgenossenschaft
Reimerstwiete 2
20457 Hamburg
(later called *SeeBG*)

Traff*Go* HT GmbH
Bismarckstraße 142
47057 Duisburg
(later called *TraffGo*)
and
Germanischer Lloyd AG
Vorsetzen 35
20459 Hamburg
(later called *GL*)

in order to explain and demonstrate the software programs Ped*Go* and AENEAS, **version 2.5.0.7** according to IMO MSC.1/Circ.1238.

Content

1 Formalities

Date: 2009-07-XX

Start: XX:XX

End: XX:XX

Location: SeeBG, Hamburg

Participants:

Name	Company	Signature
Mr. B. Kolberg	SeeBG	
Mr. T. Meyer-König	TraffGo HT	

2 Declaration of conformance

For the model underlying the simulation programs Ped*Go* and AENEAS, the assumptions of chapter 3.2 of the "Interim Guidelines for the advanced evacuation analysis for new and existing passenger ships" (IMO MSC.1/Circ. 1238, Annex 2) were applied.

The algorithms of the model and the internal parameters contain no further simplifications.

Hamburg, **XX**.07.2009

Tim Meyer-König
(proxy)

3 Comments

Ped*Go* and AENEAS are software programs for the microscopic simulation of evacuation processes. The verification of the software is done according to the “Interim guidelines for the advanced evacuation analyses for new and existing passenger ships“ (IMO MSC.1/Circ. 1238). All of the following references refer to this guideline.

3.1 Documentation of the model

The documentation of the model is done according to Annex 2, Appendix, Chapter 6.

3.1.1 Model assumptions

For the model underlying the simulation programs Ped*Go* and AENEAS, the assumptions of chapter 3.2 of the “Interim Guidelines for the advanced evacuation analysis for new and existing passenger ships“ (IMO MSC.1/Circ. 1238, Annex 2) were applied.

The algorithms of the model and the internal parameters contain no further simplifications (comp. PedGo user manual, Chapter 2).

3.1.2 Documentation of the used algorithms

1. The movement of a person is characterized by her walking speed and direction (PedGo user manual, Chapter 2).
2. The relation between the variables and parameters is described by the algorithms, described in the user manual (PedGo user manual, Chapter 2.4.1 Parameters).
3. The update of the persons movement is parallel.
4. According to table 3.5 (Appendix) stairs lead to a reduction of the walking speed. This is taken into account by a reduction factor (PedGo user manual, Chapter 2.2.4 Stairs and Jump Points) which stochastically complies with the guidelines.
5. Doors lead to a reduction of the walking speed (PedGo user manual, Chapter 2.2.3 Doors).
6. If according to Chapter 3.6.2 the embarkation and launching time (E+L) is assumed to be 30 minutes, the muster process is assumed to be completed, when all persons have reached their mustering station.

7. If data is available according to chapter 3.6.1, the embarkation phase begins, when all persons have reached their muster station and the signal for embarkation is given.
8. The actual Ped*Go* user manual is attached to this document.

3.2 Validation/Examination of the Simulation

The validation and examination of the simulation is done according to IMO MSC.1/Circ.1238, Annex 3.

The following eleven tests are taken from annex 3. A detailed description of the realization is given in the test journal.

Test 1: statistically correct

Test 2: statistically correct

Test 3: statistically correct

Test 4: the exit flow rate is less than 1.33 P/s.

Test 5: the response times lie between 10 s and 100 s.

Test 6: the corner is rounded without penetrating the walls.

Test 7: the distribution of walking speeds is statistically consistent to the specified values.

Test 8: the total time increases with the number of persons moving in opposite direction.

Test 9: the total time to leave the room approximately reduplicates, when only two of the former four doors are available.

Test 10: the assignment of exits is correct.

Test 11: congestions or the reduction of the walking speed resulting in higher densities, appear – as expected – at the exit of the room and at the lower end of the stair.

4 Test Journal

4.1 Test 1, Corridor

4.1.1 Preparations

- draw corridor with a CAD program
- import dxf file into Editor
- remove projection errors
- define exits
- insert person

4.1.2 Accomplishing the Simulation

- load project file
- adjust demographic parameters:
  - v=2 to 3 Cells per second (equally distributed values)
  - inertia is set to 10 (least swaying)
  - all other parameters are set to minimum values (0 or 1)
- execute mean value simulation with 100 runs

4.1.3 Results

The minimum peak of the walking time of all runs is at 34 s (49 times), the maximum peak is at 51 s (51 times). Since one second is required for saving the person on the exit cell, walking times have to be reduced by it. Thus, the walking speed for the 34 s is 1.21 m/s and for the 51 s it is 0.8 m/s. Therefore, the average speed is 1.0 m/s.

4.2 Test 2, Stair Upwards

The walking speed on stairs is determined automatically in Ped*Go*, based upon a reduction factor of 0.5 (small variations, depending on walking up- or downward). When the walking speed on flat terrain is set to 5 cells/s (=2,0 m/s), a person walks up the modelled stair in 10 s.

4.2.1 Preparations

- draw corridor with a CAD program
- import dxf file into Editor
- remove projection errors
- define exits
- insert person

4.2.2 Accomplishing the Simulation

- load project file
- adjust demographic parameters:
  - v=5 Cells per second
  - all other parameters are set to values which do not take effect on the result
- execute mean value simulation with 100 runs

4.2.3 Results

The mean value for the overall time is 10 s. Therefore, the average speed is 1 m/s.

4.3 Test 3, Stair Downward

The walking speed on stairs is determined automatically in Ped*Go*, based upon a reduction factor of 0.5 (small variations, depending on walking up- or downward). When the walking speed on flat terrain is set to 5 cells/s (=2,0 m/s), a person walks up the modelled stair in 10 s.

4.3.1 Preparations

- draw corridor with a CAD program
- import dxf file into Editor
- remove projection errors
- define exits
- insert person

4.3.2 Accomplishing the Simulation

- load project file
- adjust demographic parameters:
  - v=5 cells/s
  - all other parameters are set to values which do not take effect on the result
- execute mean value simulation with 100 runs

4.3.3 Results

The mean value for the overall time is 10 s. Therefore, the average speed is 1 m/s.

4.4 Test 4, Exit Flow Rate

4.4.1 Preparations

- draw room with a CAD program
- import dxf file into Editor
- remove projection errors
- define exit (2 cells wide)
- insert 100 persons

4.4.2 Accomplishing the Simulation

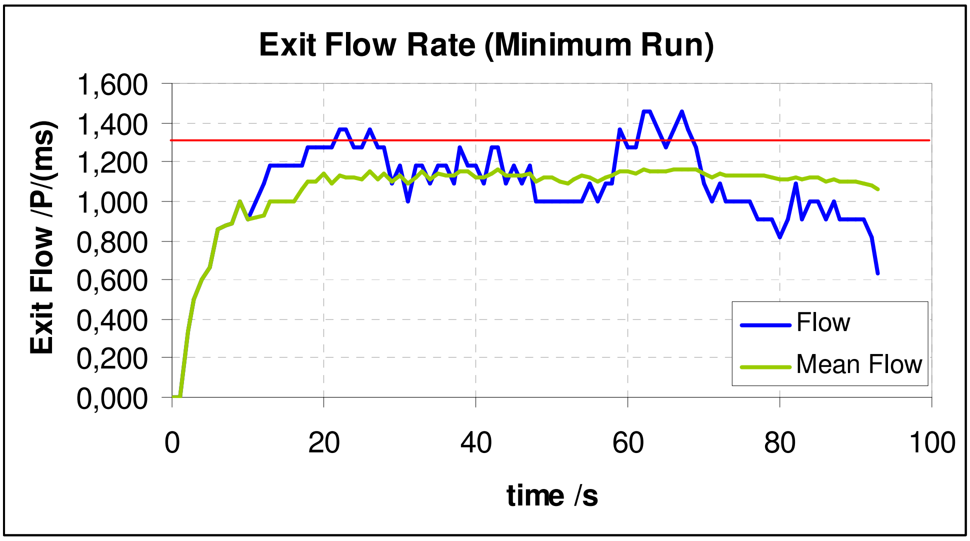
- load project file
- set demographic standard parameters
- execute mean value simulation with 100 runs
- repeat minimum run and determine exit flow rate by log point.

4.4.3 Results

The mean flow rate is determined through:

flow = number of persons / (time * exit width)

The minimum evacuation duration of all runs is 93 s. Although the exit flow rate is temporarily exceeded, the mean exit flow rate remains within 1,33 P/ms.



4.5 Test 5, Response Time

4.5.1 Preparations

- change person numbers of test 4

4.5.2 Accomplishing the Simulation

- load project file
- adjust demographic standard parameters
- set response time equally distributed to 10 – 100 s
- execute single simulation

4.5.3 Results

The response times of the persons can be evaluated from the result file. The reaction times are within the range of 10 to 100 seconds.

Person #	1	2	3	4	5	6	7	8	9	10
react /s	60	10	66	13	47	11	92	57	31	36

4.6 Test 6, Rounding Corners

4.6.1 Preparations

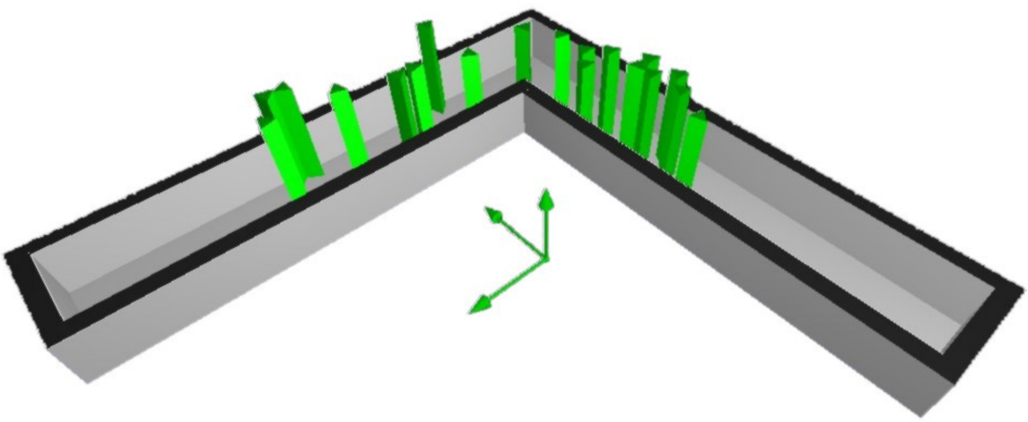
- draw corridor with a CAD program
- import dxf file into Editor
- remove projection errors
- define exit
- insert 20 persons

4.6.2 Accomplishing the Simulation

- load project file
- adjust demographic standard parameters
- execute demo-simulation

4.6.3 Results

All persons successfully round the corner without penetrating the walls.



4.7 Test 7, Assigning of Parameters

4.7.1 Preparations

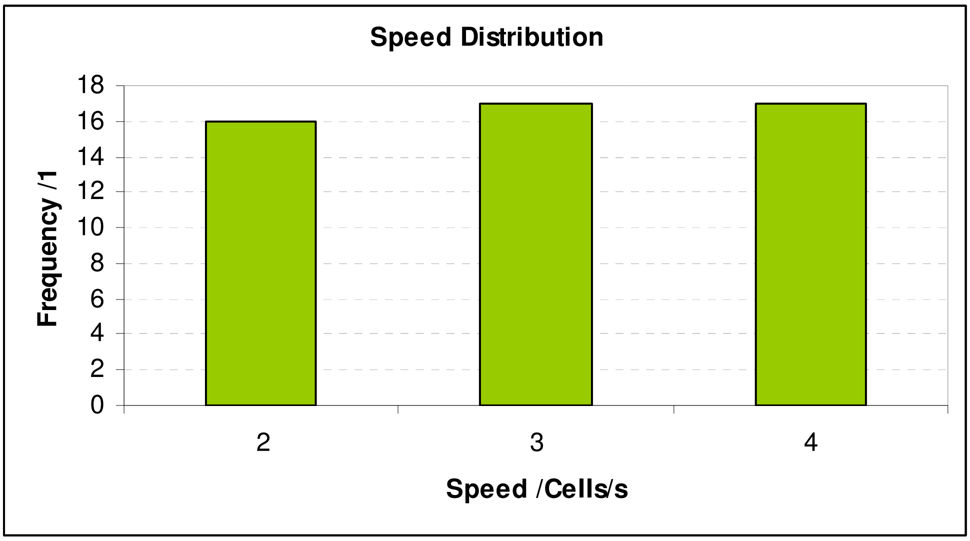
- change number of persons from Test 5 to 50

4.7.2 Accomplishing the Simulation

- load project file
- adjust demographic standard parameters
- adjust walking speed (equally distributed from 2 to 4 cells/s)
- execute single simulation run

4.7.3 Results

The parameters of the persons can be evaluated from the results file. The distribution of the velocities in the simulation is in accordance with the specified distribution in the Guidelines.



4.8 Test 8, Counterflow

4.8.1 Preparations

- draw corridor with a CAD program
- import dxf file into Editor
- remove projection errors
- define exit
- insert persons in all projects according to the described cases

4.8.2 Accomplishing the Simulation

- load project file
- adjust demographic standard parameters
- adjust walking speed (equally distributed to 2-4 c/s)
- patience disabled in order to avoid route changes
- response time = 0 s
- execute mean value simulation with 100 runs

4.8.3 Results

The stronger the counterflow, the longer it takes the persons to reach their goals. Therefore the times increase.

persons left	persons right	time (95%) /min	v2.4.3.1 /min
100	0	01:53	01:51
100	10	02:10	02:24
100	50	06:23	05:31
100	100	13:42	08:25

With enforced lane formation, the duration for the 100/100 case can be reduced to 6:03 min.

4.9 Test 9, Big Room

4.9.1 Preparations

- draw room with a CAD program
- import dxf file into Editor
- remove projection errors
- define exits
- insert persons
- save as two projects (4 and 2 doors)

4.9.2 Accomplishing the Simulation

- load project file
- adjust demographic standard parameters
- adjust walking speed (equally distributed to 2-4 c/s)
- execute mean value simulation with 100 runs for each case

4.9.3 Results

	v2.4.3.1 /min	v2.5.0.7 /min
4 doors:	3:56	2:59
2 doors:	7:20	5:30

At first it is surprising that the evacuation duration is not duplicated. The explanation for this is: When only two doors are available, the flow per door is homogeneous for a longer time and the usage of the door therefore more effective in the second case.

4.10 Test 10, Assignment of Exits

4.10.1 Preparations

- draw corridor with a CAD program
- import dxf file into Editor
- remove projection errors
- define exits
- insert persons

4.10.2 Accomplishing the Simulation

- load project file
- adjust demographic standard parameters
- adjust walking speed (equally distributed 2-4 cells/s)
- execute single simulation run and create 3D log file

4.10.3 Results

The path plot shows each person moving to its assigned exit.

4.11 Test 11, Room and Stair

4.11.1 Preparations

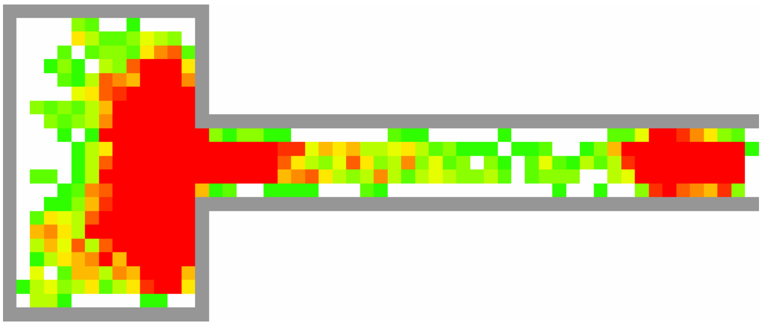
- draw geometry with a CAD program
- import dxf file into Editor
- remove projection errors
- define exit
- insert persons

4.11.2 Accomplishing the Simulation

- load project file
- adjust demographic standard parameters
- adjust walking speed (equally distributed to 2-4 cells/s)
- executing a demo-simulation

4.11.3 Results

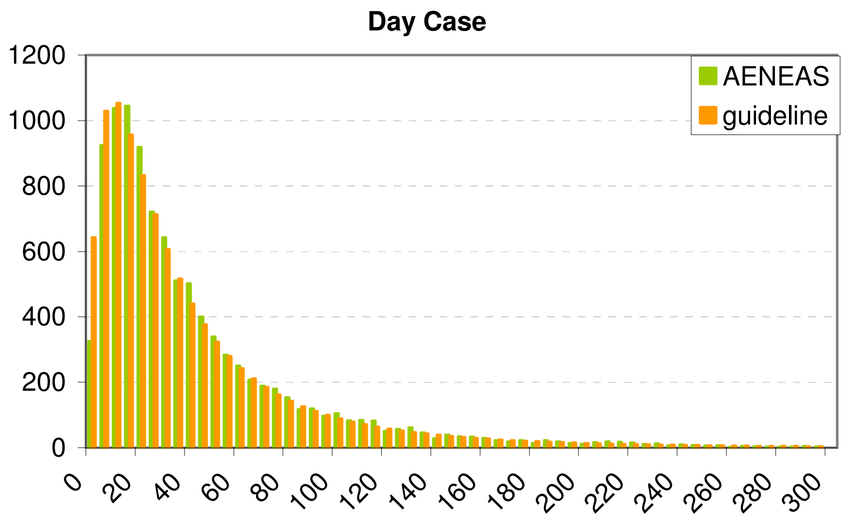
The density plot shows congestions at the exit of the room as well as on and in front of the stairs.



5 Annex

5.1 Histogramm of Reaction Times

The following figures contain the reaction times calculated analytically according to MSC.1/Circ. 1238, Annex 2, 3.2.2 and the reaction times simulated by AENEAS (10,000 persons). Those times have been taken from the results file (seed4711.xls) of a single run.



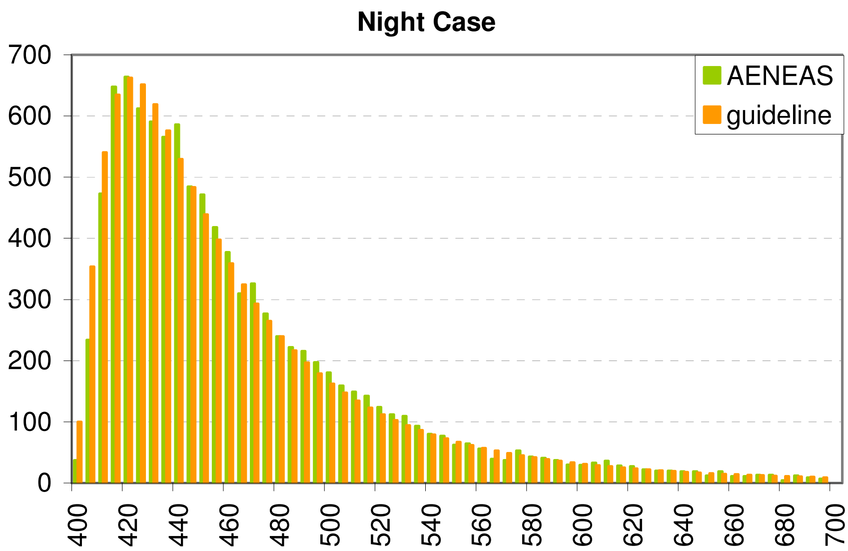


Figure 1: Histogram of the reaction times obtained analytically by the formula given in MSC.1/Circ. 1238, Annex 2, 3.2.2) compared to the times obtained by AENEAS (top: day case; bottom: night case, 10,000 persons).

5.2 User Manual

The user manual of Ped*Go* is attached to this journal. It is also publicly available at www.traffgo-ht.com.

Certificate

According to the procedure set out in the International Maritime Organization's guidelines MSC.1/Circ.1238, Traff*Go* GmbH and Germanischer Lloyd AG presented to the German *See Berufsgenossenschaft* the software programs:

PedGo and AENEASsim	Version 2.5.0.7
PedGo Editor and AENEASed	Version 2.5.0.9

The programs meet the requirements made in the "Interim guidelines for advanced evacuation analyses for new and existing passenger ships" (IMO MSC.1/Circ. 1238, Annex 2).

The model implemented in the software was explained and the software programs were tested according to the validation cases mentioned in IMO MSC.1/Circ. 1238, Annex 3.

See Berufsgenossenschaft		**Traff*Go* HT GmbH**	
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