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THE DEVELOPMENT AND VALIDATION OF A RAIL CAR EVACUATION MODEL

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ABSTRACT

In this paper we present a specialist rail car evacuation model railEXODUS, and some validation of the software capabilities using experimental data. As part of this development, an extensive review of past train accidents and rail car evacuation experimentation was undertaken. Analysis of 70 rail accidents from 1999 to 2007 involving passenger rail cars suggests that there are a number of common themes that emerge in emergency evacuation situations which will influence the way in which persons will behave and the resulting human dynamics which must be represented within the model. While accident data is useful in identifying aspects of human behaviour that must be included in evacuation models, they do not provide an opportunity to quantify human performance in emergency situations. To achieve this, evacuation experiments are essential. As part of this project, data from a series of rail car egress trials undertaken in the U.S. using U.S. rolling stock was analysed and used as part of model calibration and validation. The resulting model has the capability to simulate egress from multi-level rail cars to high and low platforms, the Right-Of-Way and inter-car egress. The model can also take into consideration the impact of fire hazards and adverse vehicle orientation on passenger behaviour and performance during emergency egress.

INTRODUCTION

While many evacuation modelling tools exist for building environments[1] and several specialist models exist for passenger ships (e.g. maritimeEXODUS[2], EVI[3], ODIGO[4]) and passenger aircraft (e.g. airEXODUS[5]), very few if any specialist validated models exist for rail car environments. In particular, no evacuation models currently exist to reliably simulate emergency egress from U.S. passenger rail cars. However, there is a wide range of potential applications for validated passenger rail car egress models including;

- Design Applications,
- Regulating Applications,
- Certification Applications,
- Passenger Train Crew Training and Emergency Management,
- Accident Investigation and
- Normal Operations.

As a result, the US Federal Rail Administration through the Volpe Centre sponsored FSEG of the University of Greenwich to develop a rail version of their EXODUS suite of software[6]. In this paper we present a specialist rail evacuation model railEXODUS, and some validation of the software capabilities using experimental data[6]. As with the other members of the EXODUS suite of software, railEXODUS is a multi-agent model which utilises a fine nodal representation of space.

TRAIN ACCIDENT REVIEW

As part of the evacuation model development, FSEG undertook an extensive review of past train accidents and rail car evacuation experimentation. The rail accident analysis involved a review of 70 accidents from 1999 to 2007 involving passenger rail cars[6,7]. Analysis of this information suggests that there are a number of common themes that emerge in rail car emergency evacuation situations which will influence the way in which persons will behave and the resulting human dynamics. These include:

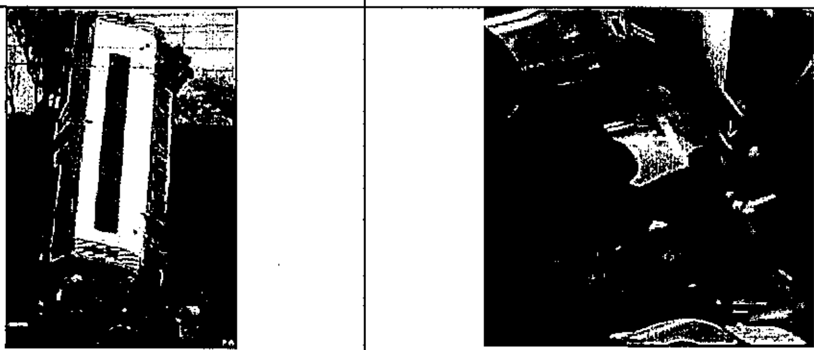
- Emergency egress situations seldom occur when the train is at a platform and so it is essential to consider egress routes to the Right-Of-Way (R-O-W) i.e. essentially the ground.
- Internal egress, in which passengers move from a place of danger to a place of relative safety within the train, from car to car often occur. Such egress routes are considered the preferred means of egress in many cases.
- Structural deformation damage resulting from the incident can eliminate normal means of egress, such as side door exits, car to car egress routes and interconnecting stairways in multi-level cars.
- Passengers may be thrown about in an accident and injured. These injuries may make self-evacuation extremely difficult and in some cases impossible.
- Passenger rail cars may completely overturn in accident situations making evacuation difficult (e.g. see Figure 1a).
- In accidents in which the rail car has overturned, it may be difficult or impossible for passengers to travel between cars even when the cars have not de-coupled.
- Passenger rail cars may be inclined at an adverse angle in accident situations. The angle of orientation at which the cars come to rest and their decoupling may make evacuation routes difficult, especially for the injured, disabled or aged (e.g. see Figure 1).
- The external physical environment either in which the accident takes place (i.e., a bridge, embankment, remote location or tunnel) or resulting from the accident (i.e., wreckage obstructing egress routes, electrical danger or fire and smoke) can have an impact on the ability to evacuate a passenger rail car (e.g. see Figure 1a).
- In some circumstances, fire may spread rapidly through the passenger rail car exposing survivors to fire hazards such as smoke, heat and toxic gases, making rapid egress essential.
- Low visibility due to smoke, dust and obscured windows may hamper rapid egress of survivors even in daylight conditions.
- In accidents at night, emergency lighting may assist passengers in assessing their circumstances and finding suitable exit routes making evacuation more efficient then it may have been.
- Passenger rail car windows may be used as an egress route by passengers and ladders may be necessary to reach passengers trapped in multi-level cars or when the car is at an angle.
  - In some accidents a significant number of passengers may be forced to exit through windows (e.g., in the Grayrigg accident[8], 34% i.e., 37/109 of the passengers exited through windows).
  - Of those exiting through windows, a significant number may exit from the high side of the overturned car (e.g., in the Grayrigg accident 54% i.e., 20/37 of the passengers using the windows exiting from the high side[8]).
- Access to and egress through windows may be made more difficult due to the orientation and position of the car.
- If the car has overturned the only way to exit the car may be through the windows that are now in the ceiling area.
- Exiting from emergency windows can be very difficult when located on an upper level of a multi-level car.
- Multilayer windows make it difficult for passengers and even emergency crew to evacuate passengers via windows (as the windows are more difficult to break).

If computer evacuation models designed to simulate evacuation from passenger rail cars are to accurately represent evacuation resulting from emergency situations involving rail scenarios, they must have the capability to address the human factors associated with these common themes. These requirements can be summarised as providing the model with a capability to allow:

- Internal egress from car to car,
- Egress to a platform,
- Egress to the R-O-W,
- Egress via car windows in upright and partially/fully overturned environments,
- Passenger movement within the car in partially/fully overturned environments,
- The impact of fire hazards on passenger survivability and mobility,
- The impact of low levels of visibility due to smoke, dust and failure of emergency lighting on passenger mobility.

Figure 1. Passengers trying to exit cars at angles following the Grayrigg accident[9]

(a) **(b)**



EXPERIMENTAL DATA

While accident data is useful in identifying aspects of human behaviour that must be included in evacuation models, they do not provide an opportunity to quantify human performance in emergency situations. To achieve this, evacuation experiments are essential. As part of this project, data from international rail car evacuation experiments were collected and reviewed[6,7]. However, these were of limited use for this project as U.S. rolling stock is different to that found in other countries and so the data collected has limited applicability to U.S. specific situations. For example, rail car exit geometries and the step down from the rail car to the platform and rail car to the R-O-W differ significantly from country to country making exiting data inappropriate for general usage unless the overall rail car and platform configurations are similar.

However, two sets of rail car egress trials were conducted by the Volpe Center in the U.S. in 2005 and 2006[6,10]. On August 25, 2005, in cooperation with the Massachusetts Bay Transportation Authority (MBTA), Volpe Center staff conducted a series of 12 egress trials at North Station, Boston, MA in order to obtain human factors data related to egress from a single-level passenger rail car[6, 10] (see Figure 2). A single group of 84 individuals participated in all the egress trials, with the exception of Trial 1, in which there were only 81 participants. Males represented 46% of the population while females represented 54%. The age of the participants were specified in three age bands, with 32% of the participants being under 30, 37% being between 30 and 50 and 31% being over 50. Only one participant self-reported having a mobility impairment. Three basic egress scenarios were conducted relating to egress from a commuter rail passenger car:

- Through one side door exit onto a high level train platform,
- Through two side door exits onto a high level train platform, and
- To an adjacent passenger rail car (also referred to as inter-car egress).

Each trial was repeated once and all the egress trials were conducted under normal and emergency lighting conditions. The primary data derived from this series of experimental egress trials consists of qualitative and quantitative data and addressed:

- aisle travel speeds,
- aisle flow rates,
- exit flow rates,
- exit flow times,
- movement between cars,
- row clearance times,
- time from seat to movement in the aisle and
- behavioural observations (deference behaviours, individual behavioural actions of note, etc.).

Figure 2. Volpe Center egress trials to high-platform

(a) Car interior	(b) Exit to high-platform
	

The Volpe Center conducted a second series of experimental egress trials, at the Boston Maintenance Facility in Somerville, MA, to obtain human factors data related to the egress from a single-level commuter passenger rail car to the R-O-W (conducted on April 19, 2006) and to a low-platform (conducted on May 31st, 2006)[6,10] (see Figure 3). These experiments consisted of two types of egress trials. The first type of egress trial involved each participant individually exiting the car, allowing measurements of individual exiting performance to be made. The second type of egress trial involved the entire group of participants exiting the car allowing both individual and group measurements of exiting performance to be made. Each egress trial was repeated five times and all were conducted under normal lighting conditions.

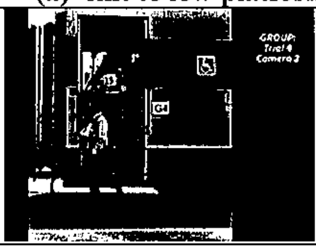
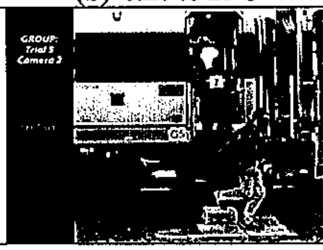
The first series of egress trials (conducted on April 19, 2006) involved the egress of a group of 15 participants to a location simulating the R-O-W, and the second series of egress trials (conducted on May 31st, 2006) involved the egress of a group of 17 participants to a location simulating a low-platform station.

The population used in the R-O-W trials involved five participants over the age of 50, one female participant of greater than 250 lbs, and one participant with a mobility impairment. In these trials, the car side door stairway consisted of four steps, producing a total stairway step distance (from side door sill threshold to bottom step) of 33 in (83.8 cm). The drop from the bottom step to the R-O-W (without the step box/pallet) was 25 in (63.5 cm), and the bottom step to step box was 16 in (40.6 cm) (see Figure 3b). The population used in the low platform trials involved four participants over the age of 50, with no participants of greater than 250 lbs, and no participants with mobility impairments. In these trials, the car side door stairway consisted of four steps, producing a total stairway step distance (from side door sill threshold to bottom step) of 33 in (83.8 cm). The drop from the car stairway bottom step to the low-platform was 15 in (38.1 cm) (see Figure 3a).

The primary data derived from this series of experimental egress trials consisted of qualitative and quantitative data and addressed:

- exiting behaviour,
- stair travel speeds, and
- exiting times.

These quantitative measurements and qualitative observations were categorised according to the egress component being observed, enabling the component to be better characterised within railEXODUS. The egress trials were recorded using a number of video cameras (supplemented through participant questionnaires and trial team observations) and the video footage was then analysed by FSEG to extract the relevant data.

Figure 3. Volpe Center egress trials to low platform and R-O-W	
(a) exit to low platform	**(b) exit to R-O-W**
	

The data were used in the following stages of the model development:

- **Design** – Qualitative data informed the types of components and behaviors which were included in the model, along with the manner in which they should be implemented.
- **Calibration** – Quantitative data informed the set of behaviours available to individual agents and then the performance levels associated with these actions. Similarly, the data was used to inform performance levels of dedicated egress components (i.e. new objects within the railEXODUS model).
- **Validation and verification** – Qualitative and quantitative data was used for comparison purposes with numerical predictions to ensure that the eventual performance of the new prototype railEXODUS software was acceptable. Verification means ensuring that the software produces results which are consistent with the model design and where available, qualitative observations; and validation means that the software produces results which are in agreement with quantitative measurements.

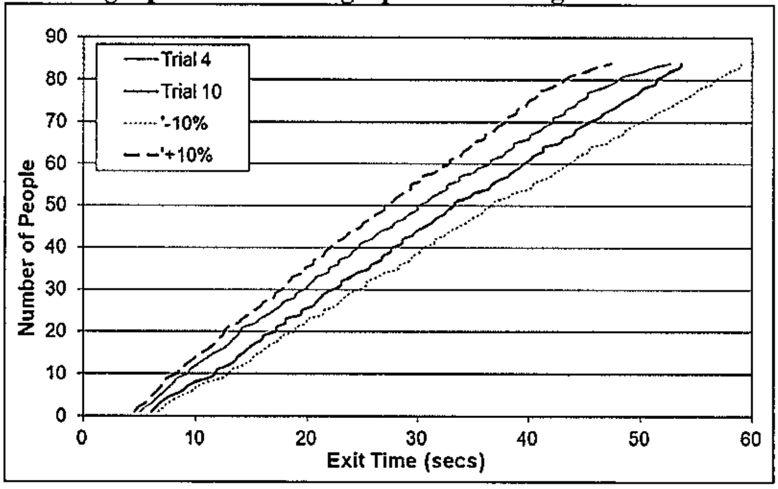
In addition to the data derived from the from the Volpe Center egress trials, additional data sources were used to supplement this data for example when considering the performance of individuals when moving through smoke (based on the buildingEXODUS data derived from Jin[6, 11] or when the car was at an incline (based on the maritimeEXODUS data derived from SHEBA[6, 12]).

Trial Series 1- Overview of High-Platform and Inter-car Evacuation Results.

A consistent finding from these trials for the exit flow rates was that there was little variation between egress trials. The lighting level, the door type, and the repeated egress trial had a negligible impact on the results produced. Under normal lighting conditions the exit flow rates (onto the high platform) ranged from 49.2 persons/minute to 53.5 persons/minute, with a mean of 51.6 persons/minute. Under emergency lighting conditions, these flow rates ranged from 48.3 persons/minute to 54.8 persons/minute, with a mean of 52.0 persons/minute. The exit flow rates for inter-car end door exit egress under normal and emergency lighting conditions were also determined. Under normal lighting conditions these flow rates ranged from 51.5 persons/minute to 53.1 persons/minute, with a mean of 52.2 persons/minute. Under emergency lighting conditions, flow rates range from 52.5 persons/minute to 54.2 persons/minute, with a mean of 53.4 persons/minute.

The graph in Figure 4 shows the exiting times under normal lighting conditions onto a high-platform using two side doors. The two curves show the results for the first trial for this scenario (Trial 4) and the repeat trial (Trial 10). The exit flow rate (given by the gradient of the line) is fairly constant in both egress trials and there is little variation between the first and second egress trials. These curves (and similar curves derived for the other scenarios considered) can be used to provide validation/verification data to demonstrate that the railEXODUS software is capable of reproducing the Volpe Center egress trials. The two curves shown in Figure 4 provide a window of variation, representing the possible spread in experimental trial results for the two side door exit to high-platform and the inter-car end door exit trials. In addition, each graph shows +/- 10% variation curves. These curves are determined by taking + 10% of the maximum trial result at any time, and -10% of the minimum trial result at any time. These curves thus provide an indication of the extent of this variation from the measured trial results. When comparing the railEXODUS software predictions for each of these cases, if the numerical predictions fall within the window produced by the variation curves, then the predictions are within +/- 10% of the measured experimental trial results.

Figure 4. Exit flow graph for exit to high-platform using two exits in normal lighting



Trial Series 2 - Overview of Low-Platform and R-O-W Evacuation Results.

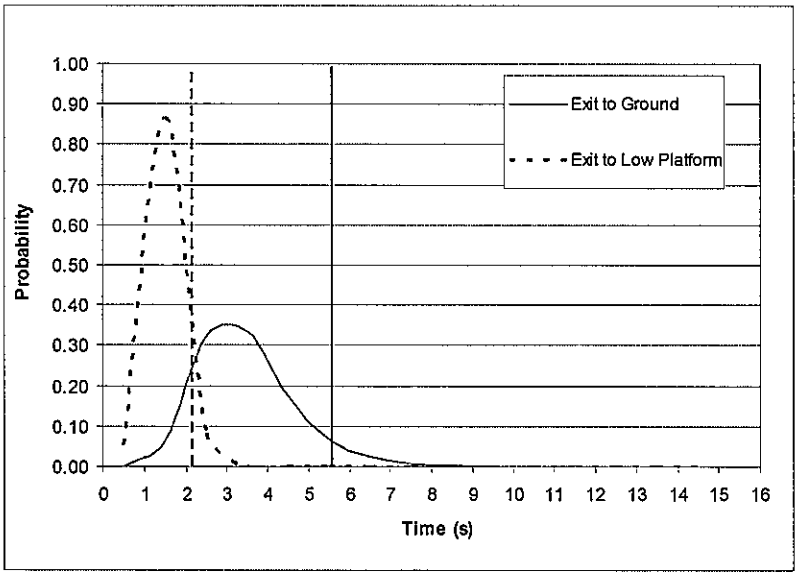
In observing each participant's exiting behaviour from the passenger rail car to the R-O-W or low-platform, it was clear that the exiting process was very different to that for participants exiting to a high-platform. While the later can be represented by an experimentally-derived flow rate, the former involves a complex process in which participants must exit through a side door exit, descend a short flight of steep stairs, and then step off the final distance from the stairway step onto the low-platform or R-O-W. For exit to the R-O-W, the distance of this final step-off can be large, and in this case it was 25in (9.8cm). This exiting process typically involves a three part process:

- Some initial hesitation as the participant decides how to approach the descent,
- Actual descent down the stairway, which for some participants may be a quite slow process,
- Final step-off the bottom of the stairway, which can also involve hesitation and can be quite slow.

However, this entire process can be longer for older participants, those with disabilities, or participants who are obese. The use of a simple flow rate to represent exit performance tends to average these personal hesitations and limitations in exiting performance, producing a crude representation of the actual passenger rail car exit flow performance. Accordingly, it is considered inappropriate to represent the exiting capabilities of these types of exit within the railEXODUS software by a simple flow rate. Rather, an exiting time probability distribution, similar to that used in airEXODUS[5] for aircraft exits (with slides, or climb through or jump down performance requirements), was considered more appropriate to represent the exit performance, in circumstances involving exit to a low-platform or to the R-O-W. Therefore, the video analysis involved extracting exiting times for each participant and producing a probability distribution of exit times to be associated with the exit for low-platforms or R-O-W. A log-normal curve was then used to represent the distribution. Within the software this distribution is converted to a travel speed probability distribution.

To compare the relative exit performance of the egress trial participants in exiting to the R-O-W and to the low-platform, the best fit probability distributions for both situations are shown in Figure 5. As shown, the time required to exit to low-platform is considerably shorter than the time required to exit to the R-O-W. The maximum time to exit to low-platform measured in the Volpe Center egress trial is 6.8 s, while the maximum time measured in the exit to R-O-W egress trial was 13.7 s. Therefore, the slowest time to exit to the R-O-W is twice as long as the slowest time to exit to the low-platform. Accordingly, the time to exit from the passenger rail car to the R-O-W shows a much wider variability in possible exit times. The modal time (i.e., the time with the highest frequency) for exiting to low-platform is 1.0 to 2.0 s while the modal time to exit to the R-O-W is 3.0 to 4.0 s, a difference of approximately 133%. Therefore, the majority of participants required 133% longer to exit to the R-O-W compared with the time required to exit to a low-platform. Also shown in Figure 5 is the 95th percentile times for each distribution. The 95th percentile time to exit to R-O-W is 5.7 s (solid vertical line), while the 95th percentile time required to exit to low-platform is 2.1 s (dashed vertical line).

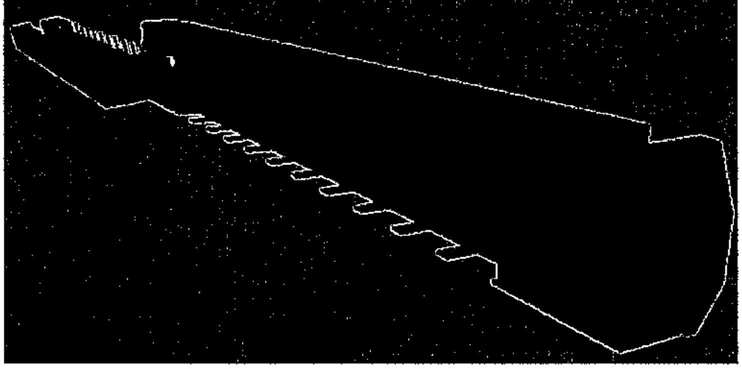
Figure 5. Exiting time probability distribution for exit to R-O-W and Low-Platform



THE railEXODUS SOFTWARE

The development of the railEXODUS software followed a three phase process. The development started with the original buildingEXODUS software and so incorporates the basic features of that software e.g. interaction of agents with fire products, ability to represent multi-level geometries, ability to produce virtual reality animations. This represents V1.0 of the railEXODUS software. Each phase of the development added new features to the railEXODUS prototype. The first phase developments extended the V1.0 software by incorporating Volpe Center egress experiment data and appropriate behaviours associated with an individual's use of internal doors and external doors onto high-platform locations, resulting in the new prototype railEXODUS V2.0 software. Data and behaviour associated with agents exiting from external doors onto low-platforms or the R-O-W were incorporated into the V2.1 software. The third phase of development enabled the software to simulate the movement of an agent in rail cars subjected to adverse angles of roll. As appropriate human factors data relating to individuals movement in passenger rail cars subjected to adverse angles of roll was not available, data from maritimeEXODUS[12] and appropriate behaviours were incorporated within the software resulting in railEXODUS V2.2 (see Figure 6). In Figure 6 the far car has a 20° angle of roll while the car in the foreground had a 90° angle of roll. It is thus possible to incorporate different angles of roll within the one scenario.

Figure 6. Representation of different roll angles within vrEXODUS



The modifications to the software are complex as changes to one of the sub-models could have an impact on the other sub-models. For example, changes to the *Behaviour* sub-model to incorporate exiting behaviour through the car side door exit onto the high-platform would also involve modifying the *Geometry* sub-model to represent a new exit type, as well as changes to the *Occupant* sub-model to incorporate additional movement rates. Interested readers should read the project report[6] to see the full range of the changes to the software. Here we briefly report on only some of the changes. Several new objects have been developed within the software to enable the representation of movement between adjacent cars, to high-platform, low-platforms and R-O-W locations. Some of the main software modifications include:

- **The *Inter-Car Conx* transit node.** This is a new Geometry Mode feature intended to represent the physical connection between passenger rail cars; i.e., passage through an inter-car end door exit to an adjacent car. Associated with this new node type are maximum flow rates for normal and emergency lighting conditions, under non-competitive egress situations. A capability to include flow rates under competitive egress situations has also been introduced.
- **The *High Plat. Exit* transit node.** This is a new Geometry Mode feature intended to represent the passenger rail car side door exit connecting to a high-platform. Associated with this new node type are maximum flow rates for normal and emergency lighting conditions, under non-competitive egress situations. A capability to include flow rates under competitive egress situations has also been introduced.
- **The *Low Plat. Exit* transit node.** This is a new Geometry Mode feature intended to represent the passenger rail car side door exit and stairway leading to a low-platform. Associated with this new node type are travel speed distributions for normal lighting conditions under non-competitive egress scenarios.

- **The *R-O-W Exit* transit node.** This is a new Geometry Mode feature intended to represent the passenger rail car side door exit and stairway leading to the R-O-W. Associated with this new node type are travel speed distributions for normal lighting conditions under non-competitive egress situations.
- **The *Car Aisle* node.** This is a new Geometry Mode feature intended to represent the terrain associated with the main car and vestibule aisles leading to the side door exits. Associated with this node type are a range of associated movement behaviour rules for non-competitive and competitive egress situations.
- ***Modelling the effect of car angles of inclination on agent mobility.*** The movement sub-model was extended to enable the effect of given angles of roll and pitch on agents to be determined, thereby enabling the agent corresponding mobility values (and thus travel speeds) to be adjusted to simulate the overall effect of exposure (see Figure 6).

It is important to note that it is also possible to incorporate the geometry of the environment in which the rail car is situated within the railEXODUS scenario. Thus it is possible to include a platform, station, tunnel or other outside space within the railEXODUS scenario.

VERIFICATION AND VALIDATION

In order to validate the new railEXODUS V2.2 software, a total of six model scenarios were simulated. These correspond to the six different experimental egress trials conducted by the Volpe Center in trial series 1. The geometry of the cars within the railEXODUS V2.2 software, including seating arrangements, was constructed from drawings supplied by the Volpe Center. The geometry used to model each of the required scenarios is comprised of two connected passenger rail cars. Within each model scenario only one rail car was initially populated, with the adjacent left car being unoccupied (see Figure 7). Full details of the validation and verification analysis can be found in[6], here the results from one of the validation cases is presented.

Figure 7. Geometry Layout used in all Egress Simulations (Left Car is Unpopulated)

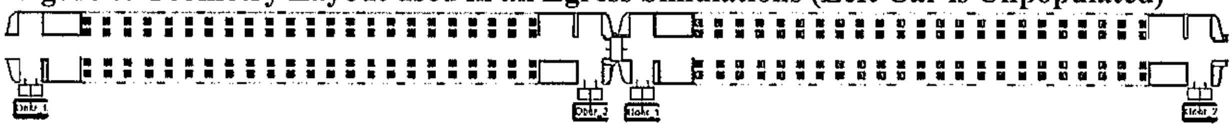


Figure 8 shows the experimental curves (Trials 4 and 10), the ±10% variation curves and the model prediction for the two door exit to high-platform scenario in normal lighting conditions. The figure shows that the predicted exit history curves falls within the window generated by the experimental results and therefore is well within the ±10% variation curves.

An attempt was also made to compare predicted aisle densities with those measured in the egress trials. Figure 9 shows an initial direct comparison between predicted and measured congestion levels within the car for Trial 2 (exit to adjacent car in normal lighting conditions). Trial 2 was selected for the analysis since it provided an ideal scenario to gauge crowd densities as they build up along the main aisle. In Figure 9a, significant aisle congestion can be seen developing in the aisle from the centre of the car towards the rear. This situation occurs after approximately 6 s. Also evident is the large number of participants standing within the seat rows attempting to enter the aisle. In Figure 9b, a similar situation occurs at approximately the same time. Although the exact positions of individual persons may vary, the overall predicted aisle density and queuing within seat rows closely matches that observed within the egress trials.

A more detailed analysis was completed in which the density within the car aisle was approximated using various video images from the same point in time. The measured densities varied from 3.01 persons/m^2 to 4.18 persons/m^2 while the predicted densities varied from 3.41 persons/m^2 to 4.52 persons/m^2. The minimum density was over predicted by **14%** while the maximum density was over predicted by **8%.** The average measured density throughout the aisle was 3.54 persons/m^2 while the predicted average aisle density was 3.96 persons/m^2. The average aisle density was over predicted by **12%.** It is noted that while measuring the number of persons within a given space is straight forward with railEXODUS, estimating the number from egress trial video data is difficult and subject to error. Using the video data to determine when a participant is partially within the rail car aisle is not straight forward due to camera angles and as a result is subject to interpretation. As a result, the estimated numbers of participants derived from the egress trial video data, especially in high density regions are approximate. These results suggest that railEXODUS is capable of producing a realistic representation of the crowd densities that develop during egress trials.

Figure 8. Two door exit to High-Platform experimental results and model predictions

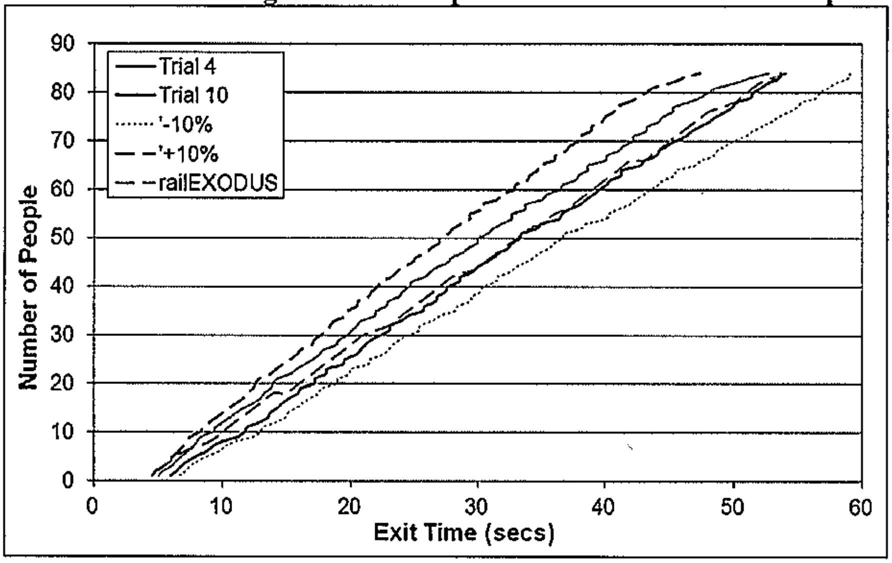


Figure 9. Congestion evident towards the rear of the passenger rail car after 6 seconds

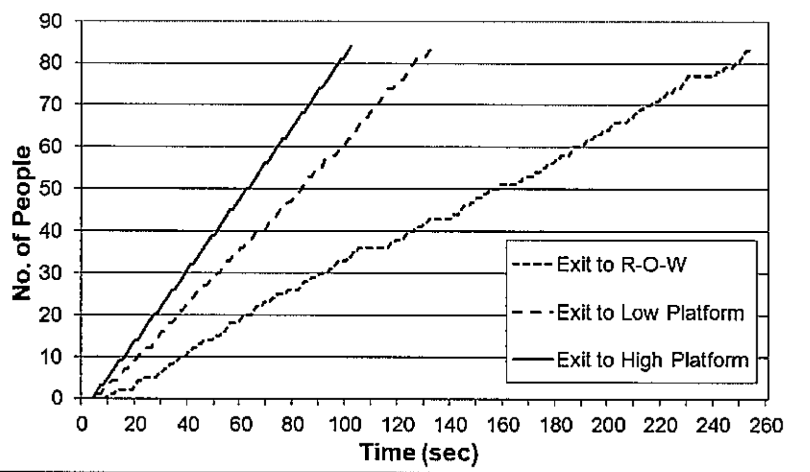
(a) Trial 2

(b) vrEXODUS

Finally, model predictions from three hypothetical scenarios are presented which compares the egress of 84 passengers from a rail car geometry through a single car side exit to (a) a high platform, (b) a low platform and (c) the R-O-W. Each model scenario was repeated 250 times, with the agents changing seat locations after every 10 runs. The average egress times derived from the 250 simulations of each scenario is presented in Figure 10. The significant differences in performance for the three scenarios is due to the nature of the exit types and is not influenced by possible population influences e.g. a slow passenger placed near or far from an exit. Comparing the exit times for egress involving 84 agents to a high-platform, low-platform, and R-O-W, the average egress times were; 102 s, 133 s and 254 s respectively (see Figure 10). The egress to the R-O-W was 2.5 times longer than the evacuation to the high-platform, while the egress to the low-platform was 1.3 times longer than the egress to the high-platform. The differences between these simulations are a result of the average flow rate achieved in each scenario. For the exit to high-platform scenario, the average exit rate was 52 persons/minute (0.87 persons/s), while for the exit to the R-O-W, the average flow rate was 20.6 persons/minute (0.34 persons/s). The relative ordering of these software predictions are consistent with reasonable expectations, with the exit to an R-O-W through one side door exit taking longer than the exit to high-platform.

It is noted that unlike rail cars in the UK (and Europe), in the U.S., exit of passengers to the R-O-W is aided by an integral stair which extends part way to the R-O-W. In a similar U.K. (or European) evacuation, egress to the R-O-W can be expected to take considerably longer as passengers must effectively jump from the door sill to the R-O-W, a distance of 1.0m or more.

Figure 10. Exit curves for one side door exit to high-platform, low-platform and R-O-W



CONCLUSIONS

In this paper the development and capabilities of the railEXODUS evacuation model have been presented. The model has the capability to represent the following scenarios:

- Egress from single or multi-level rail cars.
- Egress scenarios involving fire (fire data from CFD or Zone fire models can be utilised).
- Inter-car egress.
- Egress to high and low platforms.
- Egress to the R-O-W.
- Egress from rail cars which are fully or partially overturned.

Results from a series of validation and verification simulations have also been presented. These demonstrate that the software is able to reproduce the results from a series of rail car evacuation experiments involving evacuation to a high-platform with good accuracy. These results include egress time histories and internal crowd densities. Verification cases concerning egress to high-platform, low-platform and the R-O-W also suggest that the software is capable of producing plausible results with regards to relative performance in each case. While not demonstrated in this paper, it is noted that the software is also able to incorporate evacuation within stations, tunnels and outside environments, not simply the rail car. While the data used within railEXODUS is specific to U.S. rolling stock, data for other rail cars can easily be incorporated through the software user interface.

DISCLAIMER

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