Simulated Ditching: Evacuation Into Water

Garnet A. McLean, Ph.D.
Cynthia L. Corbett, M.A.
David A. Palmerton, M.S.

Protection and Survival Research Laboratory
FAA Civil Aerospace Medical Institute

Introduction

- Certification procedures for ditching scenarios are not specified in the FARs, but §25.801(d) states, "it must be shown that, under reasonably probable water conditions, the flotation time and trim of the airplane will allow the occupants to leave the aircraft and enter the liferafts required by §25.1415."
- This has generally been demonstrated via flotation-time analysis for each new airplane type.
- VLTAs will conduct many extended over-water operations, which raises questions regarding assumptions in the flotation-time analyses.
- Specifically, the distance from the exit sills to the water line may range from just a few inches to over 6 ft. and create significant deviations from the passenger flow rates into the water assumed historically for transport airplanes.
- Such deviations may also exist for new narrow-body airplane types with long fuselages, for which unfavorable flotation attitudes could also produce exit sill heights from water level to several feet.
- Differences in personal flotation devices and their modes of operation can add to such variances, as could the exit type through which passengers must egress.

- To provide information relative to these certification questions, the CAMI Protection and Survival Research Laboratory studied simulated egress into water.

- Subjects jumped from a platform, configured with a simulated Type A (42" wide) dual-lane floor-level exit or a simulated Type I (24" wide) single-lane floor-level exit, erected at heights of 0.75, 2, 4 and 6 feet above the surface of the water.

- Three different personal flotation device conditions were also investigated; subjects jumped into the water:

  - while holding typical transport airplane flotation seat cushions,
  - while wearing TSO (C13) approved inflatable lifevests (inflated),
  - while wearing the TSO-approved lifevests (uninflated) until
  - after entering the water and then inflating them.

- The goal of the research project was to provide best-case estimates of the egress times (flowrates) into water that could be expected through each of the simulated exit types, at each of the simulated exit sill heights, for each of the different personal flotation devices.

Methods

Experimental Design. **Four groups of 20 to 31 (mean = 25) subjects completed 12 experimental evacuation trials in a 3 (flotation device) by 4 (platform height) repeated-measures design, using either the Type A or Type I exit. Flotation-device and platform-height conditions were counterbalanced within each group to minimize bias.**

Flotation Device Order	S VU VI	VI S VU	S VI VU	VU S VI
Group 1 Platforms	.75’	2’	4’	6’
Group 2 Platforms	6’	4’	2’	.75’
Group 3 Platforms	4’	6’	.75’	2’
Group 4 Platforms	2’	.75’	6’	4’

S = Seat cushion / VI = Vest inflated / VU = Vest uninflated

Subjects

Two hundred medically-fit participants, ranging in age from 18 to 50 years of age, weighing less than 300 lbs. each, divided almost evenly with respect to gender (m = 95 / f = 105), and with the ability to swim 2 lengths of the CAMI survival tank, were employed in the study. They wore long pants, a T-shirt style top, and shoes; they also wore a TSO C-13 approved inflatable lifevest or clutched a typical transport airplane flotation seat cushion.

Safety Personnel

Two Red Cross/CPR certified lifeguards were stationed at the edge of the water alongside the survival tank near the platform during all trials and a SCUBA diver was positioned in the water at the side of the platform for water safety concerns. Four additional research personnel were stationed around the pool to provide assistance in the unlikely event that a subject needed to be helped out of the water.

Apparatus

A 144 ft^2 adjustable-height platform (Figure 1), configured to produce either a simulated Type A or Type-I exit, was constructed alongside the CAMI survival tank. The platform was essentially 12’ x 12’ square, except that a 4’ x 4’ section at the left rear of the platform was removed and replaced with stairs, with the removed section being attached to the center of the platform at the edge of the survival tank to form a protruding “passageway” that participants used to approach the simulated exit. A 3-ft high side rail was erected around the platform for participant safety, except that the rail did not enclose the front edge of the section protruding over the water.

Figure 1
Platform Configuration

Experimental Situation

- Side rails with foam blocks formed Type A or Type 1 exit
- The sliding doors simulated fuselage.
- Subjects completed their 3 simulated egress trials at each height.
- Two personal flotation devices were used to create 3 flotation-device conditions as subjects:

    1) wore a pre-inflated lifevest when jumping into the water
    2) wore a non-inflated lifevest when jumping through the exit that they inflated upon entering the water,
    3) clutched the flotation seat cushion as they jumped through the exit and entered the water.

- Video cameras with time-code generators were strategically located to time subjects jumping from the platform into the water; underwater activity was also recorded by video camera from below (Figure 3).

Figure 2
Passageway/Exit Restriction Produced by Foam Blocks

Figure 3
Underwater Observation

Procedure

- **Subjects had to swim 2 lengths of the CAMI survival tank.**
- **They were then briefed about the scenario.**
- **They had to "get out" by jumping as fast as possible and moving away.**
- **They were instructed <u>not</u> to jump onto any of their fellow passengers.**
- **They were shown how to operate an inflatable lifevest (Figure 4),**
- **They were shown the proper way to grasp a flotation seat cushion (Figure 5).**
- **They were given either a lifevest or a flotation seat cushion and directed to the platform.**
- **They formed either a dual- or single-lane queue. to the**
- **Using only 1 type of exit, each group performed in all 3 flotation device conditions and at all 4 platform heights.**

Figure 4
Proper Method to Inflate Lifevest

Figure 5
Proper Method to Hold Flotation Seat Cushion

Results

•Group ranged from 21 to 31 (mean = 25) subjects, thus, average individual egress times were used.

• Times for the Type A (dual-lane) exit were somewhat shorter than those with the Type I (single-lane) exit (0.16 sec, ($p<.05$).

• No interactions of exit type were found with either platform height or flotation device.

•

• Platform height effects were larger (0.71 sec, $p<.0001$

• The 6-ft high platform yielded significantly slower egress than at 4 feet (Duncan's; $p<.05$).

•No interactions of flotation device type and platform height were found, although an interactive trend ($p<.06$) of exit type, platform height, and flotation device type was displayed, resulting from particularly slowed egress with the inflated lifevest through the Type A exit with increasing platform height.

Figure 6
Platform Height Effects With The Type A Exit

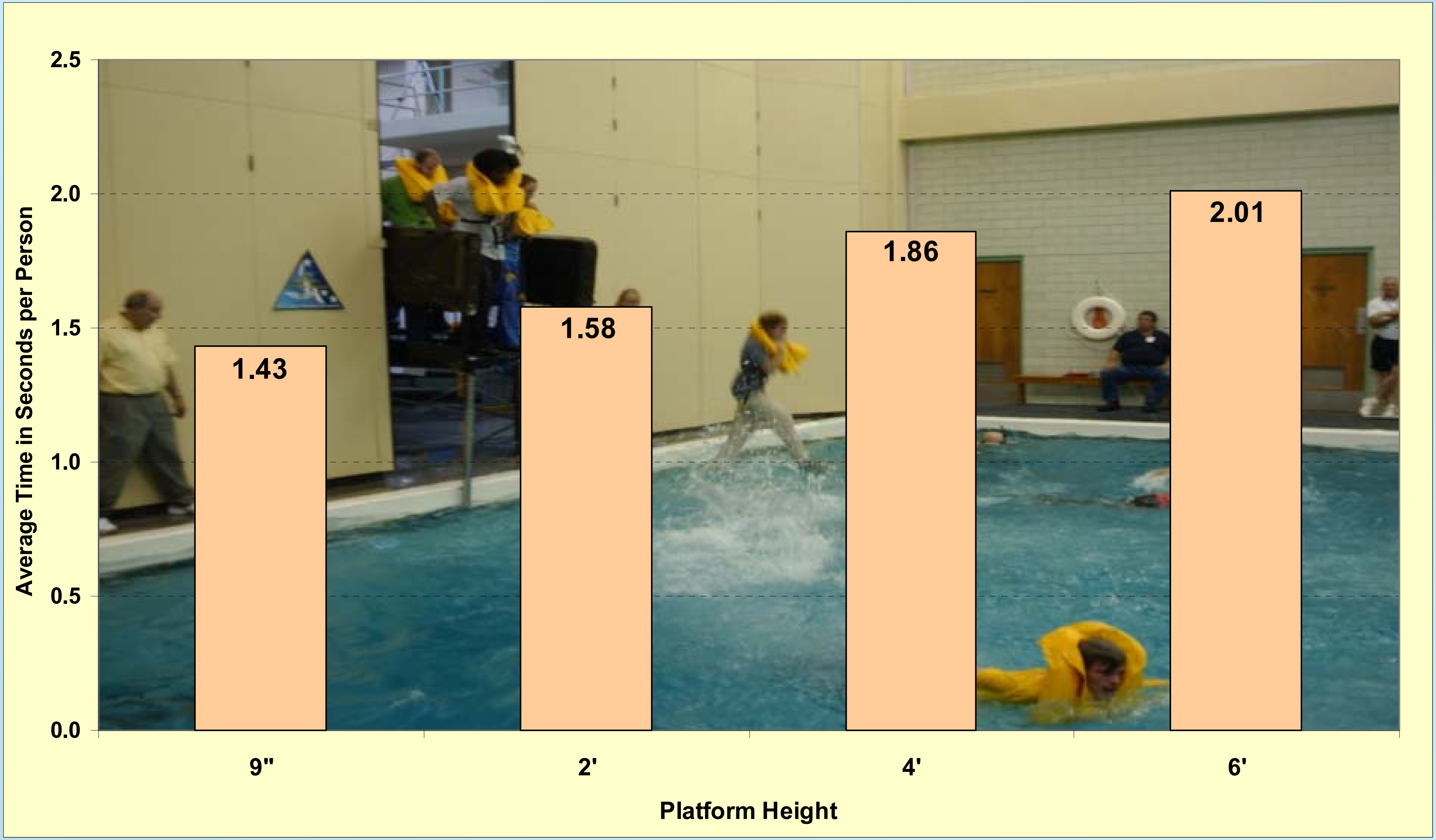


Figure 7
Platform Height Effects With The Type I Exit

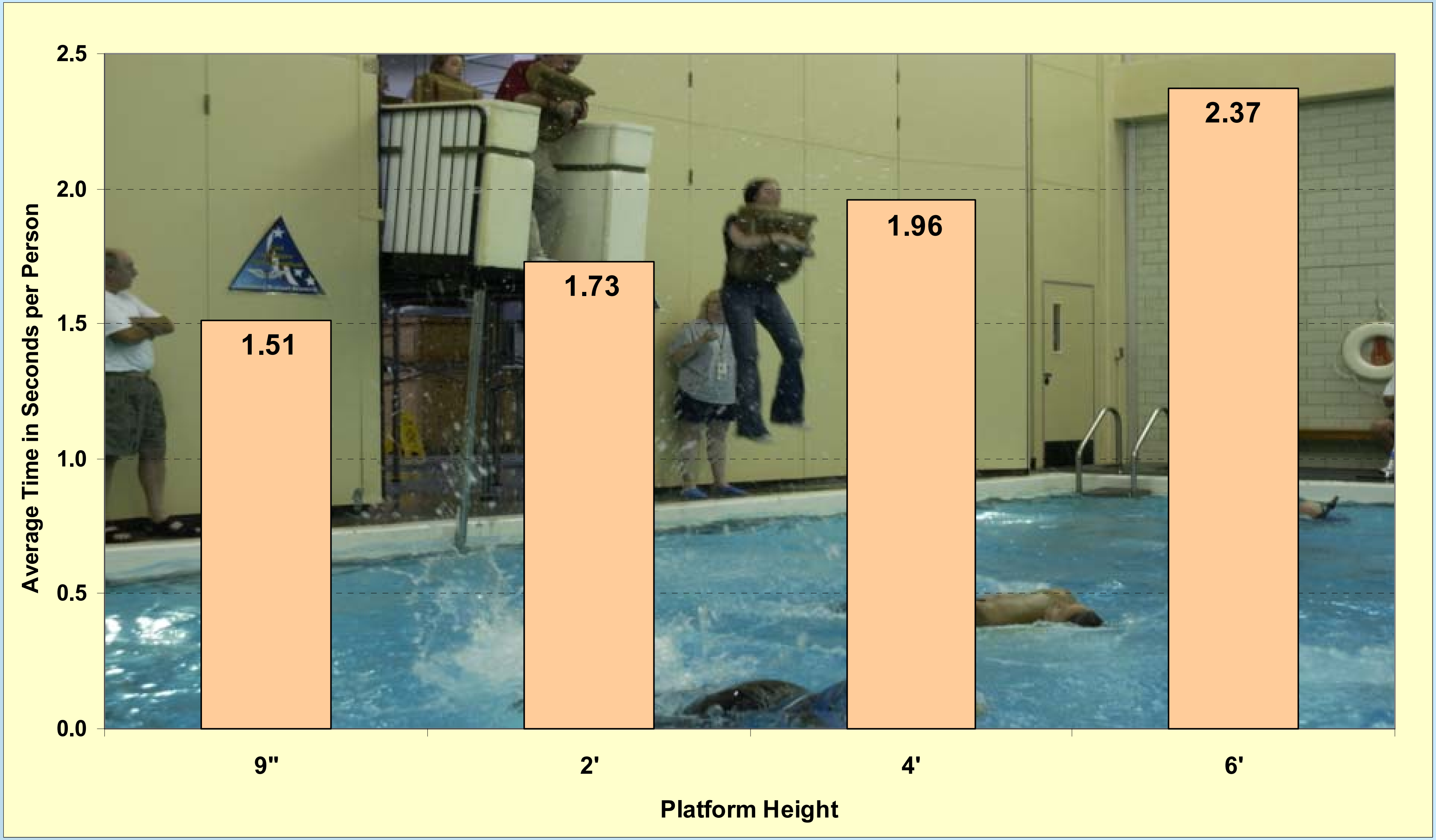


Figure 8
Flotation Device Effects With The Type A Exit

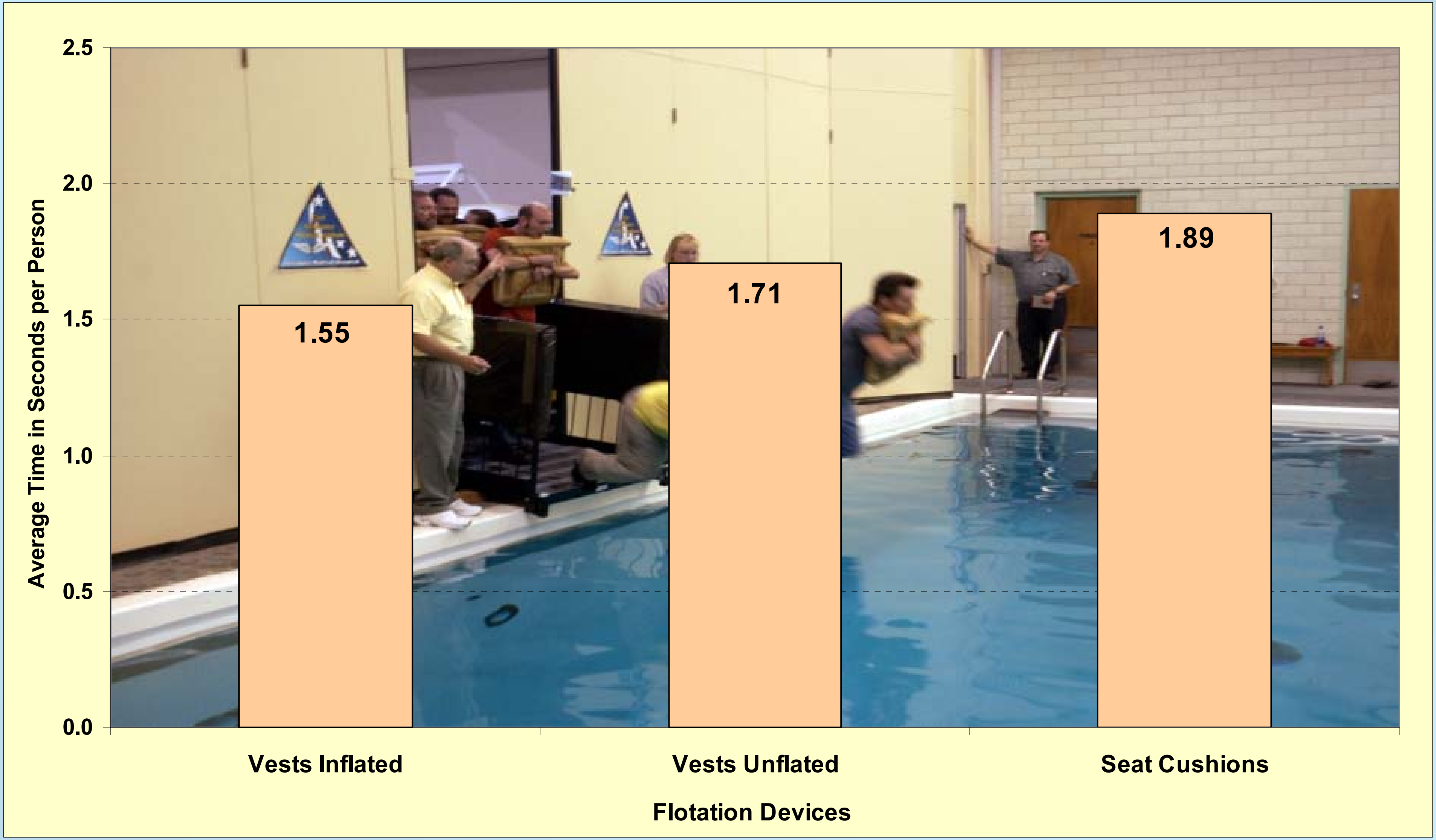
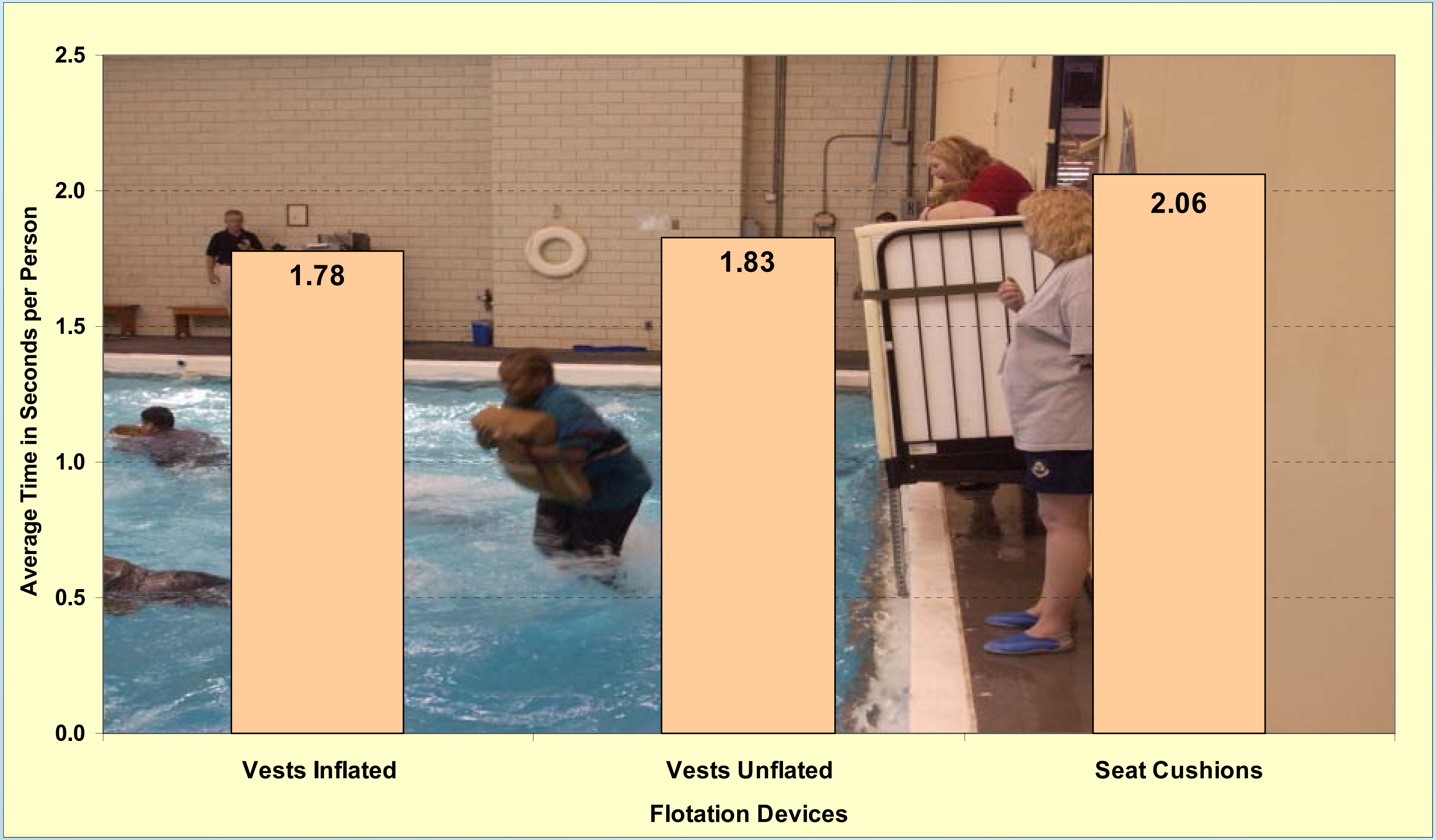


Figure 9
Flotation Device Effects With The Type I Exit



Discussion

- Exit Type
- Platfrom Height
- Flotation Device Type
- Application to Certification
- Application to Operations