WHAT'S IN A WORD?

V. Quentin Bates, Lerch, Bates & Associates, Littleton, CO, USA

ABSTRACT

Communication is difficult even when only two people discuss a commonly understood topic or idea. Elevator Engineers need to use common terms to describe elevator performance in order to improve communication. This chapter discusses work underway in the United States to develop an "Elevator Performance Matrix" by a committee of the "National Elevator Industry, Inc." (NEII) trade organization. All interested parties are invited to become involved, and to support standardized terms and measurement of elevator performance.

1 ETYMOLOGY

The January, 1993, issue of *National Geographic* includes a feature article on dinosaurs. When you hear or see that word, you probably have an immediate mental image of a large, lizard-like creature living millions of years ago.

In fact, the word DINOSAUR covers some 350 known species ranging from pigeon size to Diplodocus which measured almost 90 feet in length and weighed over 20,000 pounds. When I say dinosaur, I could be meaning Velocoraptor, you could be understanding Tyrannosaurs. To communicate with complete understanding requires much more definition than the single name, dinosaur. The value of a well defined word - most people have a common understanding of its meaning.

What did I do when confronted with your likely understanding of "dinosaur"? I tried to further define the meaning using words with almost universal acceptance and understanding. First, I conveyed an impression of size using a familiar bird as a reference. Secondly, I used words in the English system of measurement, feet and pounds. (Alternately, the length and weight measure of the metric system - metres and kilograms - could have been used.) When we use well defined and accepted words, we can communicate with complete understanding without endless discussion trying to establish exactly what we mean.

2 APPLICATION TO THE VERTICAL TRANSPORTATION FIELD

In our chosen field, vertical transportation, we have the same type of problem when we discuss elevator/lift performance. Ah, if only we could have words and phrases for elevator performance measurement which carry the clarity of, "feet" or "metres".

Perhaps for those of us in the U.S., this wish is coming closer to reality. At the LBA FORUM meeting at Beaver Creek, Colorado (June, 1992), some 100 Elevator

---

The name dinosaur was first used in print in 1842 by the English anatomist Sir Richard Owen, when it became clear that newfound fossils were from an unrecognized animal group. Owen combined two Greek words - deinos, or "terrible," and sauros, or "lizard," to describe the remarkable creatures.

Consultants and Engineers spent a day discussing possible standards which could be used to describe individual group elevator performance. A recent article in *Elevator World* by George Strakosch mentioned that discussion, and outlined work presently underway by the National Elevator Industry, Inc. (NEII) Performance Standards Committee. George, representatives of member elevator companies and Ed Donoghue, the NEII Code Advisor, have been meeting periodically for over a year to develop a "Performance Terminology Matrix" which will be included as a part of the NEII publication, "Vertical Transportation Standards".

Winter and spring meetings of the New York Forum of the National Association of Vertical Transportation Professionals (NAVTP) focused on trying to agree upon a foundation for carefully defining elevator performance. These discussions were moderated by John Van Duesen and included some 30 prominent Elevator Consultants from the Eastern United States.

Work from the LBA Forum and the New York Forum have been submitted to the NEII Performance Standards Committee as background for their matrix development, and to a similar committee which I chair, for NAVTP. The purpose of these seemingly diverse efforts is to produce a single standard for performance measurement which can be used by the elevator industry.

Too often in the world, we work independently, without sharing our thoughts and information. Right now, forces in the U.S. are focused on this task. It is important that standards which have already been developed in other countries, or which are being considered, can be identified and reviewed as this work is being accomplished. IAEE should foster global use of well defined, common terms. My purposes in this article are to review background on work being done and to enlist your interest, possible participation, and most importantly, your support in using common terminology for describing measurement of individual and group elevator performance as recommendations are published.

As NAVTP began discussions some simple guidelines were established:

1. Agree upon a word or phrase which can be used to describe a measure of individual elevator performance which is descriptive of the action being measured.

2. Establish a simple definition which is specific for that word or phrase.

3. Develop simple instructions for measurement which would be "standard" for the particular word or phrase.

4. Leave the setting of appropriate values for the "standard" being measured to the individual consultant, company, etc.

Information sent to each possible attendee prior to the NAVTP winter meeting covered six of the items reviewed at the LBA Forum:

1. Speed
2. Door Opening Time
3. Door Closing Time
4. Door Open Duration Time
5. Floor to Floor Performance Time
6. Stopping Accuracy

The first word, "speed", initiated immediate discussion. Would the word, "velocity" be more appropriate or should velocity be used in the definition of speed? The discussion, from that first question, became complex, somewhat strident and more opinionated. Still, some three hours later, there arose from the melee, general consensus on the "word/phrase" and "definition" portions of Table 1. This information was sent to each NAVTP Member for comment. At the spring meeting, "Word/Phrase" and "Definition" items were finalized and "Measurement" methods were discussed and included in a draft covering the six "word/phrase" items selected for NAVTP's effort.

TABLE 1: Individual Elevator Performance Measurement Terms and Definitions

WORD/PHRASE	DEFINITION	MEASUREMENT NOTES
Speed (velocity)	Rate at which the elevator moves in the travel direction	Measure speed as the highest sustained value recorded during a complete run of the unit in the travel direction
Door opening time	Start of door(s) opening until fully opened	Measure time from the moment the car door(s) start to open until l they are fully open (i.e., Opening motion stops)
Door closing time	Start of door(s) closing until fully closed	Measure time from the moment the car door(s) start to close until they are fully closed (i.e., Motion stops)
Door open duration time	Time door(s) remain fully open	Measure time from the stop in opening motion until the start of closing motion
Floor-to-floor performance time	Time required for the movement of the car between two floors including door closing and door opening	Measure time from the start of car door closing at one floor until the car is stopped within stopping accuracy at the destination floor with the doors effectively open for passenger transfer(32" or 800mm).
Stopping accuracy	Distance vertically between car and hoistway sills when the car is stopped at a floor	Measure vertical distance between the horizontal planes of the car and hoistway sills when the car is stopped at the floor.

3 REFERENCE BACKGROUND

Table 2 and those which follow contrast matrix information developed by NAVTP and NEII Committees along with some research background on the particular performance item from the following references:

- ASME: "A17.1 Safety Code for Elevators and Escalators", American Society of Mechanical Engineers, 1990.
- NEIEP: "Elevator Terms: an illustrated glossary", National Elevator Industry Education Program (US), 1980, (private publication).
- Barney, G.C.: "Elevator Micropedia", International Association of Elevator Engineers, 1988.
- Strakosch, G.R.: "Vertical Transportation: elevators and escalators", Wiley Interscience, 2nd Edition, 1983.
- Barney, G.C. and Dos Santos, S.M.: "Elevator Traffic Analysis, Design and Control", IEE/Peter Pergrinus, 2nd Edition, 1985.
- McGuinness, W.J. and Stein, B.: "Mechanical and Electrical Equipment for Buildings", John Wiley, 5th Edition, 1971.

The hope is that summarizing this information in the Tables 2-7 which follow will demonstrate the difficulty in reaching consensus, and enlist your efforts to support such consensus.

4 CONCLUSION

So much for six of the words and phrases which might be used in a lexicon of individual elevator performance. The NEII Matrix has fifty entries, and group performance has not been started. The attempts presently underway in the U.S. to reach consensus on words and phrases used to describe elevator performance are long overdue there. I suggest that we all consider the matrix being developed by NEII. Possibly, it can be adopted by IAEE, NAVTP and other consulting, academic and engineering organizations to facilitate communication and understanding throughout the worldwide "Elevator/Lift" community.

WHAT'S IN A WORD? - If properly defined and accepted by those using it, it is a shorthand method to convey understanding without argument or the possibility of misunderstanding.

SPEED

The word, "speed", is probably more appropriate than velocity simply because its use is so common in all elevator literature. Though not defined in *A17.1, NEIEP Elevator Terms*, or any of the several references consulted, the term is universally used in every piece of elevator literature in which the rate of elevator movement is discussed. Paraphrasing *World Book Encyclopedia*, velocity is the rate at which a body moves in space in a given direction, while speed is the rate of motion in any direction. Since speed and velocity have different definitions, we should probably not use velocity in the definition of speed.

TABLE 2: SPEED

NAVTP

WORD/PHRASE	DEFINITION	MEASUREMENT NOTES
Speed (velocity)	Rate at which the elevator moves in the travel direction	Measure speed as the highest sustained value recorded during a complete run of the unit in the travel direction

NEII

ITEM	TERM	DEFINITIONS	MEASUREMENTS How Measured	Range/Accuracy
6.0	Contract speed	The speed of an escalator, dumbwaiter of elevator specified in the approved contract abstract, usually expressed as ft/sec (m/s).	Measured using a tachometer under specified load condition in either direction.	Tachometer capable of measuring fpm (m/s).

REFERENCE BACKGROUND

A17 Codes	NEIEP Elevator Terms	Elevator Micropedia	Vertical Transportation	Elevator Traffic Analysis	Equipment for Buildings
▸ "operating speed in down direction" ▸ "rated speed" (definition) ▸ Various references to, "speed..." ▸ No reference to velocity noted in definitions or index	▸ "speed" is referenced ▸ "velocity comparator" referenced as a device to control, "speed"	▸ "speed: contract" referenced ▸ No reference to velocity	▸ "speed" used as general term when discussing car motion ▸ "velocity" used in discussion of elevator travel - "velocity vs time". In formula, symbol "v" used for velocity (speed)	▸ Symbol "v" used to designate "contract speed" ▸ "speed" used as general term when discussing car motion	▸ "speed" used as general term when discussing car motion

DOOR OPENING TIME

Two elements of the NAVTP definition and measurement notes are significant in reviewing these Words/Phrases.

1) Defining opening and closing as *fully* open or closed.
2) Basing measurement on motion of car doors.

Defining an open door as, "within 1 or 2 inches of fully open", was discussed but this seeming contradicts the ground rule of simplicity. Further, in evaluating the quality of door operation, action at the limits of travel is very important.

TABLE 3: DOOR OPENING TIME

NAVTP

WORD/PHRASE	DEFINITION	MEASUREMENT NOTES
Door opening time	Start of door(s) opening until fully opened	Measure time from the moment the car door(s) start to open until they are fully open (i.e. opening motion stops)

NEII

ITEM	TERM	DEFINITIONS	MEASUREMENTS How Measured	Range/Accuracy
12.0	Door full open time	Time required from start of car door motion to 2 in. (51 mm) from clear door opening..	Measured in seconds inside car from start of door(s) open motion to 2 in. (51 mm) from extreme door(s) open position. Measured at a typical landing.	Stopwatch capable of measuring in tenths of a second. Record to nearest tenth.

REFERENCE BACKGROUND

A17 Codes	NEIEP Elevator Terms	Elevator Micropedia	Vertical Transportation	Elevator Traffic Analysis	Equipment for Buildings
▸ "hoistway door power opening" reference ▸ "car door or gate" - power opening reference	▸ This term used. Fully open defined as , "...(Usually) 2" from the return jamb."	▸ "time, door opening" defined as, "the period of time measured from the instant of the elevator being level at a floor and when the doors are 90% open."	▸ Term used in basic definitions is, "powered door opening time." ▸ shown as , "door open time" , in figure 19.4 On page 453	▸ This term used with measurement made until doors are 90% open. Symbol, "t_o" used.	▸ No specific reference. The time for door opening included in, "door operations."

DOOR CLOSING TIME

Finally, since the suggested measurement of Door Open Duration Time starts at the stop in opening motion, measurement of the opening time to that movement seems logical. Likewise, since the powered component of most passenger elevator door systems is the car door, this is the logical focus for measurement for horizontally moving doors. (A modified or separate definition should probably be developed to cover vertically moving powered hoistway doors).

TABLE 4: DOOR CLOSING TIME

NAVTP

WORD/PHRASE	DEFINITION	MEASUREMENT NOTES
Door closing time	Start of door(s) closing until fully closed.	Measure time from the moment the car door(s) start to close until they are fully closed (i.e. motion stops)

NEII

ITEM	TERM	DEFINITIONS	MEASUREMENTS How Measured	Range/Accuracy
10.0	Door close time	Time required from start of door close until car door panel motion stops.	Measured in seconds inside car from start of door close to end of door motion. Measured at a typical landing.	Stopwatch capable of measuring in tenths of a second. Record to nearest tenth.

REFERENCE BACKGROUND

A17 Codes	NEIEP Elevator Terms	Elevator Micropedia	Vertical Transportation	Elevator Traffic Analysis	Equipment for Buildings
▸ "door closing force..." Reference ▸ "hoistway door closing, power closing" references ▸ "average closing speed" is measured 1 " or 2" from open jamb to 1" to 2" from opposite jamb or center meeting point. ▸ "closed position" of hoistway doors is defined "within 3/8" of contact with each other" or "nearest face of the jambs"	▸ This term used with measurement 2" or 1" from open jamb position to 2" or 1" from close jamb or meeting.	▸ "time, door closing" defined as, "the period of time measured from the instant that the door close pushbutton is pressed (or the first visible door movement) until the door interlocks are made up."	▸ Term used in basic definitions is, "powered door closing time." ▸ Index reference is, "door closing time" ▸ Shown as, "door close time" in figure 19.4, Page 453.	▸ This term used with definition, "a period of time measured from a door command (often the first visible movement of a door) until the interlocks are made-up on the landing doors most often the cessation of door movement)" with the symbol "t_c". ▸ Measurement given from first movement to fully closed.	▸ Term used in connection with door operation description, as the, "time to close doors."

DOOR OPEN DURATION TIME

There are many phrases in current use for this condition - "door hold open time" and "dwell time" come immediately to mind. The phrase used by NAVTP seems descriptive of the action being measured and is one which should be understood by a person unfamiliar with elevator jargon. Possibly, someone may come up with an even better phrase. The important point, as with all elements of the matrix, is that once established, we should all accept and use that word/phrase in conversation and writing.

TABLE 5: DOOR OPEN DURATION TIME

NAVTP

WORD/PHRASE	DEFINITION	MEASUREMENT NOTES
Door open duration time	Time door(s) remain fully open	Measure time from the stop in opening motion until the start of closing motion.

NEII

ITEM	TERM	DEFINITIONS	MEASUREMENTS How Measured	Range/Accuracy
3.0	Door hold open time	Time from full door open until door starts to close for the following conditions.	Measured in seconds inside the car from time door open motion completed to start of closing motion under the following conditions.	Stopwatch capable of measuring in tenths of a second. Record to nearest tenth.

REFERENCE BACKGROUND

A17 Codes	NEIEP Elevator Terms	Elevator Micropedia	Vertical Transportation	Elevator Traffic Analaysis	Equipment for Buildings
▸ Note: ADA uses the term, "door delay" as "the... Time for elevator doors to remain fully open..."	▸ "door open time" defined as, "length of time doors stand open after reaching full open portion until doors start to close provided no signal is received to shorten door time."	▸ "time, door dwell" defined as, "the time that the elevator doors are held open at a landing, after the door opening sequence has been completed." "Time, door holding" is also referenced with note, "see time, door dwell"	▸ "dwell time" is described as, "... The time doors remain open at a floor..." "Refinements" to the basic time are discussed.	▸ "door holding time" defined as, "the time that a car doors are held open at a landing." With the symbol, "t_h" ▸ "doors opened time" also used.	▸ No reference

FLOOR TO FLOOR PERFORMANCE TIME

Note the generic nature of the NAVTP definition. While performance time is generally measured between successive floors, this definition leaves the number of floors open.

Whether performance time should be measured until doors are fully open, rather than effectively open, is a subject for discussion. The rationale for setting 32" or 800 mm (assuming the car is at rest within stopping accuracy) seems a good measure of the effectiveness of motion control and door operation as they relate to passenger movement from entry, until exit is possible. This also defines the point at which the car should be stopped at the floor.

TABLE 6: FLOOR TO FLOOR PERFORMANCE TIME

NAVTP

WORD/PHRASE	DEFINITION	MEASUREMENT NOTES
Floor-to-floor performance time	Time required for the movement of the car between two floors including door closing and door opening	Measure time from the start of car door closing at one floor until the car is stopped within stopping accuracy at the destination floor with the doors effectively open for passenger transfer (32" or 800mm).

NEII

ITEM	TERM	DEFINITIONS	MEASUREMENTS How Measured	Range/Accuracy
29.0	Performance time	Time required from start of door close to doors open 32 in. (813 Mm) at adjacent floor, within a specified stopping zone.	Measured in seconds inside the car from the start of door close to door open 32 in. (813mm) at an adjacent floor within a specified stopping zone. Measured using a typical floor height.	Stopwatch capable of measuring in tenths of a second. Record to nearest tenth.

REFERENCE BACKGROUND

A17 Codes	NEIEP Elevator Terms	Elevator Micropedia	Vertical Transportation	Elevator Traffic Analaysis	Equipment for Buildings
▸ "rated load performance" defined.	▸ "floor to floor time" defined as "... Run from one floor to the next."	▸ "time, cycle" defined as one floor run from doors start to close until doors start to close.	▸ "operation from floor to floor" is discussed. ▸ "...Floor to floor operations", is also used. ▸ Figure 19.4 on page 453 shows, "floor to floor time", as start of doors closing until doors fully open.	▸ "interfloor flight time" referenced and discussed. Symbol given is, "$t_f(n)$" where (n) is the number of floors traveled. Time does not include door operation.	▸ no reference

STOPPING ACCURACY

Elevator people probably use the term, "Leveling Accuracy", more frequently than the phase suggested. *NEIEP Elevator Terms* includes a definition of leveling,

"The *movement* (my italics) of an elevator toward the landing sill when it (the elevator) is within the leveling zone."

The definition goes on to explain the inference that this process automatically results in a level stop.

The word, "stopping" seems appropriate to differentiate "leveling" (the movement process) from "stopping" (end of movement). It seems more descriptive of the action being measured.

TABLE 7: STOPPING ACCURACY

NAVTP

WORD/PHRASE	DEFINITION	MEASUREMENT NOTES
Stopping accuracy	Distance vertically between car and hoistway sills when the car is stopped at a floor.	Measure vertical distance between the horizontal planes of the car and hoistway sills when the car is stopped at the floor.

NEII

ITEM	TERM	DEFINITIONS	MEASUREMENTS How measured	Range/Accuracy
37.0	Stopping zone	The distance above or below a landing sill the car is allowed to arrive at for a final stop without a demand for releveling or position change.	Measure the vertical difference between adjacent sills, at the center of the opening, immediately after car arrives at a landing and before load transfer.	Ruler capable of measuring in fractions of an inch (mm).

REFERENCE BACKGROUND

A17 Codes	NEIEP Elevator Terms	Elevator Micropedia	Vertical Transportation	Elevator Traffic Analysis	Equipment for Buildings
▸ Various references to "stop" & "stopping" in connection with condition when car is at rest. ▸ "leveling" defined as "controlled car movement toward the landing... To attain a predetermined accuracy." ▸ Various references to "leveling" as a zone or device.	▸ "leveling" defined as "movement of an elevator toward the landing sill..."	▸ "leveling" defined as, "an operation which improves the accuracy of stopping...	▸ References "leveling" in conjunction with discussion of "the accuracy with which <an elevator> levels to the floor..."	▸ No reference	▸ Reference to "automatic leveling"