Ride Quality Indexes – Unfortunately, It's Not That Easy.

By Michael Gerardi

Yes or No. On or Off. Hot or Cold. Paper or Plastic.

Wouldn't it be nice if everything could be solved with as few of choices as possible? Life would be simpler. Unfortunately, life isn't that simple. And neither is quantifying the ride quality of a runway. A variety of indices have been developed to try to quantify the ride quality of a pavement. These indices attempt to provide a yes or no answer for pavement acceptance and when trying to identify areas of roughness.

However, the severity of an aircraft's response, like the response of any other vehicle, is largely based on the speed of encounter. Consider this example; imagine that you're driving a car and encounter a speed bump at 5 mph (8 kph), you will probably classify the vehicle's response to be acceptable at that slow speed. However, if you encountered that bump at 50 mph (80 kph), you would probably classify the vehicle's response to be much, much worse. At this point, you may be reading this and saying to yourself that this is common-sense, what's your point? Well, the point is that the indexes we use today to evaluate the ride quality of pavements *do not* account for the vehicle's speed. This fact makes these indices unreliable in their ability to characterize the pavement's true rideability.

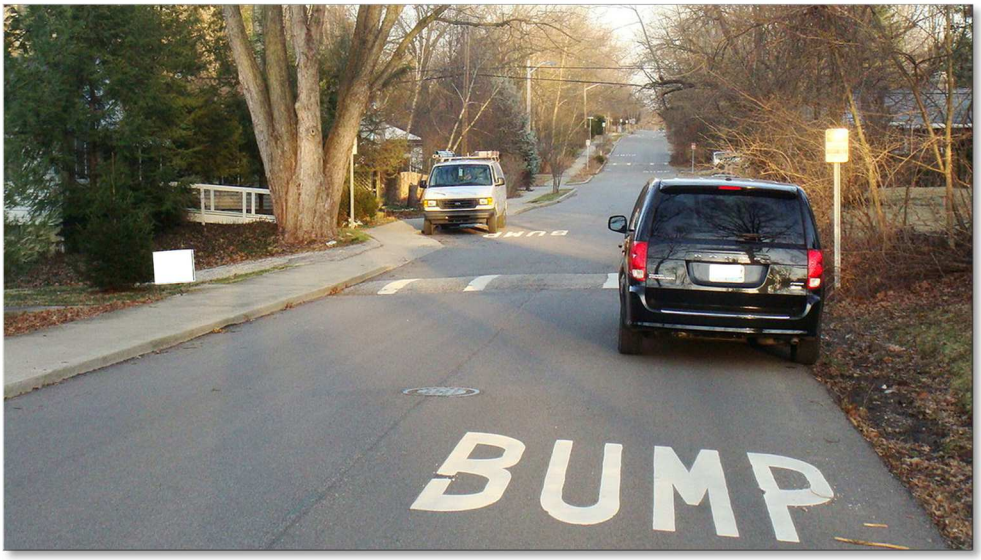

Figure 1. At what speed would the response to this bump become unacceptable?

With that in mind, let's look at the more common methods used to evaluate a pavement's ride quality.

- **The Profile Index:** This index produces an "inches per mile" value based on the vertical displacement of a sensor wheel located in the middle of a 25-foot (8m) frame. Values of

7 inches (13cm) per mile or less are considered acceptable and will result in no penalties for new airfield pavement.[1]

- First, let's get one thing clear about the California Profilograph and the Profile Index; it is used to evaluate *construction quality,* not *smoothness from an aircraft response perspective*. Unfortunately, this device/method is frequently used to try to find areas of reported roughness.
- The Profile Index looks only at profile characteristics. It does not care where the event is located and, therefore, the speed of encounter. Secondly, the wavelengths detected by this device can only be about 25 feet (8m) in length. This wavelength limitation brings about its own issues.

- **The Boeing Bump Index (BBI):** The Boeing Bump Index looks at event amplitude vs event wavelength. This is then plotted and categorized as either *Acceptable*, *Excessive* or *Unacceptable*.
  - Because the BBI can evaluate a bump or dip of any length, it is better than the traditional Profile Index technique. But, because it is an index, it doesn't take event location into account and therefore, the speed of encounter.
  - Another issue with the BBI is that it can only detect single-event roughness, not multiple events in succession.
- **The International Roughness Index (IRI):** IRI uses an algorithm to predict the vertical displacement of a single automotive strut in relation to the measured pavement profile. Like the Profile Index, it adds up the inches the strut is predicted to move up and down in relation to the measured profile and produces an *inches per-mile* index.
  - Unlike the other indexes, the IRI does use speed in its algorithm. In this case, the car is moving at a constant 30 mph (48 kph).
  - While the IRI can be effective for some short wavelength roughness detection, it is limited because it models a car – not an airplane. The long wavelength events that can affect aircraft response will be missed when using the IRI.

Realizing that many of the methods used to evaluate areas of roughness are limited, what method can you use to effectively evaluate *all types* of pavement roughness?

APR's answer to this question is to use aircraft simulation. Aircraft simulation can predict the aircraft's response to *any event* measured on the runway at *any speed*. This technology has proven to be very effective at not only identifying and quantifying areas of roughness, but also determining a pavement's true smoothness as an aircraft experiences it, not a Profilograph. As mentioned earlier the Profilograph or the 12-foot (4m) straightedge provides you with construction quality information. It's not very useful for evaluating the pavement for aircraft response.

[1] As quoted in FAA AC 150/5370-10G, Section P-401-8.1d

To wrap this article up, indices are used to help categorize a situation to be either acceptable or unacceptable. They're easy to understand and use. Unfortunately, they can be unreliable when trying to identify roughness that affects aircraft response. If you have an aircraft response problem, it's likely the indices mentioned in this article will not provide you with all the answers you need. APR's customers use aircraft simulation. Simulations see the problem as an aircraft sees it. If you want to know more, I'd be happy to talk about it with you. mag@aprconsultants.com.