Industry *insights*

IPEX's industry insights is a series of expert opinion thought leadership articles on issues on today's railways.

Are you sitting comfortably?

In recent years, ~~M~~many ~~new~~ trains ~~are being~~have been introduced with seats that are generally considered less comfortable than the seats on the trains they replace. Measure of seat comfort has always been a difficult aspect of train specification, and ~~the most~~a common solution to the problem has been not to write anything at all. This has resulted in the situation where, as train manufacturers strive for slimmer seats to improve the overall capacity of the train and meet the customer's capacity targets, so the comfort of the passenger gets ignored. This article investigates some of the issues surrounding seat comfort and puts forward a recommendation for future research.

The dilemma

The first impressions of ~~time I rode on~~ the new Thameslink train when they ~~– that's a nice looking train I thought~~ were introduced were that they were a marked improvement on those they were replacing. However, much was written about the seats. As one passenger reported:

~~. Then I sat down in the seat.~~ Within two minutes I had back ache and had to stand up. Fortunate~~ly,ly~~ I was only going from St Pancras to Blackfriars. Imagine if I was going from Bedford or Brighton to London? I would have to choose to stand for the journey or buy a cushion.

~~So spoke a passenger giving their impression of the new Class 700s operating on Thameslink.~~ Unfortunately, this seems to happen more and more frequently. ~~Testing the~~The ~~new~~ Class 374 Eurostar trains got a similarly poor reception when compared with the original seats in the Class ~~.~~373.~~,~~ ~~after 10 minutes, one's rear end was quite numb. Two hours to Paris could well be construed as some form of torture. At this point, if one puts two and two together and notes that both these trains are from one manufacturer would result in scoring five, as the seats are manufactured by different companies.~~

~~IEP~~ The Class 80x AT300 seats have also been written about. Roger Ford and Ian Walmsley both have written extensively on the subject of uncomfortable seats. So what has~~'s~~ happened?

IFD	Example
6 – 12	Bed pillows, thick back pillows
12 – 18	Back pillows, upholstery padding, wrap
18 – 24	Thin back pillows, tufting matrix, very seat cushions, wraps
24 – 30	Average seat cushions, upholstery pa tight seats, certain mattress types, quil
30 – 36	Firmer seat cushions, mattresses
36 – 45	Thin seat cushioning and firm mattress
>45	Shock absorbing foams, packaging f carpet pads, and other uses requiring ultra-firm foams

~~As mentioned in the opening paragraph,~~O~~ o~~ften seat comfort is ignored in new train technical specifications. That is~~'s~~ because it ~~i~~'s ~~actually~~ quite ~~hard~~ difficult to determine ~~(please excuse the pun)~~. One specification from 15 or so years ago stated seats should be "no harder than the existing trains" conveniently leaving ~~to~~ the manufacturer to determine the answer. ~~Or so the writer thought.~~ The manufacturer merely produced a seat and suggested the customer prove if they could that the seats were harder ~~if they could~~than the predecessor version. ~~Stalemate.~~

Seat comfort measure

Seat comfort potentially has suffered as fire regulations have ~~got~~ become more stringent, meaning that manufacturers ~~will~~ reduce the foam inside a seat to the smallest possible amount to ensure the tests are passed.

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Added to which, there is an ever-increasing demand to increase the number of seats in a vehicle. This can be achieved by increasing the length of the vehicle as demonstrated by Hitachi's AT300 design, but also by slimming the seat back.

However, seat hardness can certainly be measured; there However, seat hardness can certainly be measured; there is a standard commonly used by the Polyurethane Foam Association to measure indentation force deflection (IFD).

IFD is defined as the amount of force, in pounds, required to indent a fifty square inch, round, indentor foot into a predefined foam specimen by a certain percentage of the specimen's total thickness. ~~For example the table above gives values at 25% Deflection (lb/50 insq. on 20"x20"x4"). However, is it fair to say that seats are uncomfortable because they aren't soft enough?~~

Table 1: Indentation force deflection values

IFD	Example
6 – 12	Bed pillows, thick back pillows
12 – 18	Back pillows, upholstery padding, wraps
18 – 24	Thin back pillows, tufting matrix, very thick seat cushions, wraps
24 – 30	Average seat cushions, upholstery padding, tight seats, certain mattress types, quilting
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One size does not fit all

For many years, anyone over about six feet tall found that travelling by train, although infinitely more comfortable than a bus, was still not the most comfortable exercise. This was often indicated by the rapidity in which the priority seats were taken up as they give that extra legroom .

Additionally, ~~some~~ seats on some trains have been set lower than knee height and leaves the tall user in an ungainly and uncomfortable semi-squat position. The seats on the BR multiple units that use the Mk3 bodyshell are classic examples of this, as are the "Mallard" seats on the Mk4 carriages. Interestingly the original Mk3 seats, although of similar height, are more comfortable, ~~presumably~~ because they are ~~slightly~~ more reclined. The question then is, what anthropometric data is being used for seat design, and does it represent the modern demographic of travellers?

A glimmer of an idea

For many years, ~~the~~In ~~the~~ IPEX York "office" used ~~the~~ desk seating accommodation ~~for the desk is in the form of~~ an IKEA chair made of laminated plywood. It ha~~d~~s no cushioning at all, excepting the gas strut, and yet an eight-hour session in front of the computer wais not a chore, and twelve-hour stints ~~have~~ were~~been~~ undertaken without ill effect. So why should this be so comfortable and yet some more padded seats be less so? Office chairs are designed to be sat in all day. Seats on trains are not, but intercity trains should really be designed with that same ethos.

The immediate answer is that the office chair can be adjusted. The IKEA chair is not a fancy seat; it only has one adjustment, but a crucial one – seat height.

The main requirement of a comfortable upright seat is that the user's upper legs are parallel with the floor supported by the chair along their length. If the seat is too high, undue pressure is put on the back of the legs behind the knees, and if too low, undue pressure is put on the lower back.

Concluding remarks

Imagine if height adjustable seats were introduced onto passenger trains? There would be obstacles to overcome, such as how to work the mechanism and how to make it robust enough to cope with the demands of the travelling public and the occasional wilfully destructive occupant.

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However, research into this may well provide the answer to the comfortable ride that has alluded so many recently. Given the plethora of research ~~into seating~~ such as the "adaptable carriage" for carrying freight off-peak, there is no reason to suggest that such a concept would not attract funding or that the funding would be misplaced.

2021 update

Since ~~this~~ the original version of this IPEX Insight thought leadership article was published in 2017, RSSB has conducted a research project "~~:~~Defining the requirements of a seat comfort selection process"~~:~~ (reference T1140) on behalf of the Vehicle ~~Vehicle~~ Vehicle Systems Interface Committee (V~~-~~V ~~S~~IC) and the Seat Comfort Group. This has already seen industry take-up with First ~~Rail~~Group, making use of the research findings to inform its rolling stock procurements, most notably for its forthcoming East Coast open access operation.~~.~~

IPEX Consulting is a bespoke consultancy providing trains systems commercial engineering solutions across the global railway industry.

Chris Hoskin is IPEX's ~~an Associate~~Technical Director ~~with IPEX Consulting~~. He has 22~~1~~9 years' experience in the UK, Europe, Asia Pacific, and ~~North~~ Americas, having developed a career specialising in rolling stock while having a deep understanding of the rail industry systems interactions. He specialises in procurement, decarbonisation, development of standards, both national and local, strategic planning and due diligence, and the development and use of remote condition monitoring equipment.

Contact: c.hoskin@ipexconsulting.com, 07970 287 834

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