Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Top graph on page 122

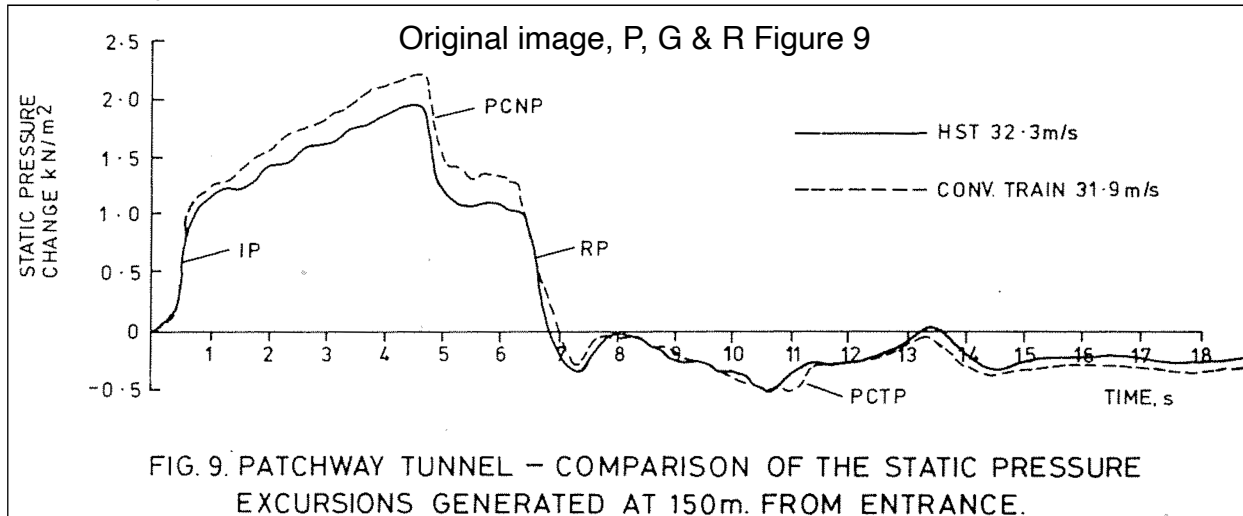Test place & time: Patchway Old tunnel (single track, no shafts), early 1980s

Tunnel length: 1140 m, tunnel area: 22.71 m^2, tunnel perimeter: 18.19 m

Conventional train: 2 class 50 locomotives plus 8 MkI coaches. Length 203.2 m, area 8.2 m^2, perimeter 9.82 m, speed 31.9 m/s (114.8 km/h)

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 32.3 m/s (116.3 km/h)

Data in the image: measured static pressure 150 m from the entry portal.

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, P=0 Pa), (t=18 s, P=0 Pa), (t=0, P=-500 Pa) and (t=0, P=2500 Pa). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-9.tar' into webplotdigitizer for more details.

Original image, P, G & R Figure 9

FIG. 9. PATCHWAY TUNNEL — COMPARISON OF THE STATIC PRESSURE EXCURSIONS GENERATED AT 150m. FROM ENTRANCE.

IP = Initial pressure rise (due to nose entry)

PCNP = Pressure change, nose passing the sensor

RP = Reflected primary wave arrives at the sensor

PCTP = Pressure change, tail passing the sensor

Comparison of the image to the digitised data

Source files: 1982-PGR-Fig-9-DP.txt and 1982-PGR-Fig-9-rotated-P.png.

Page 1
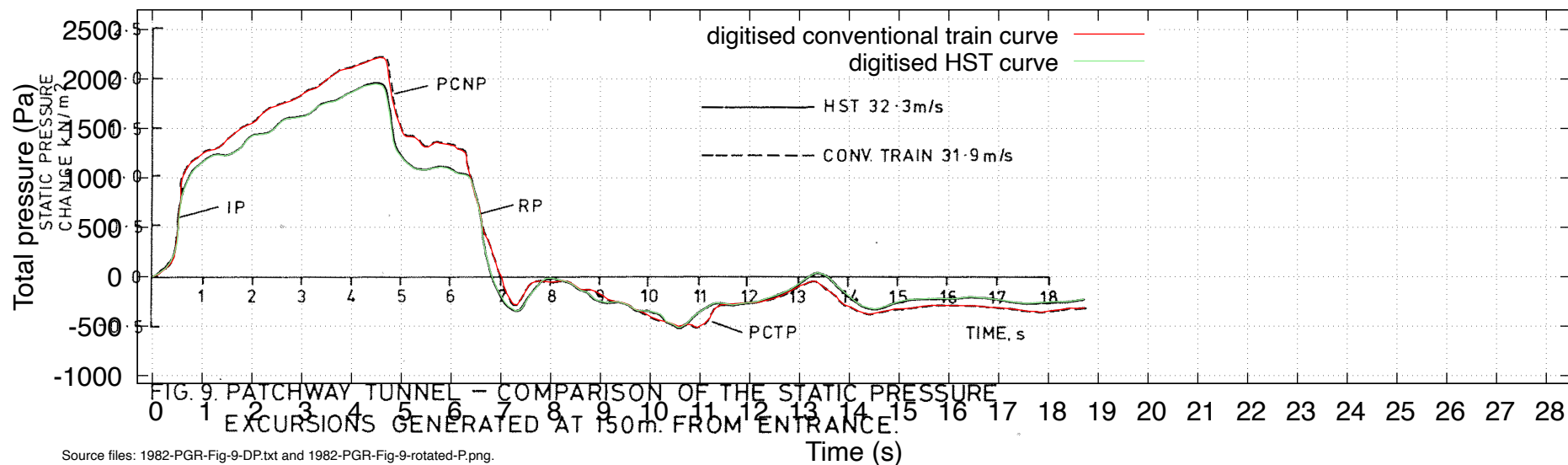
Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Middle graph on page 122
Test place & time: Patchway Old tunnel (single track, no shafts), early 1980s
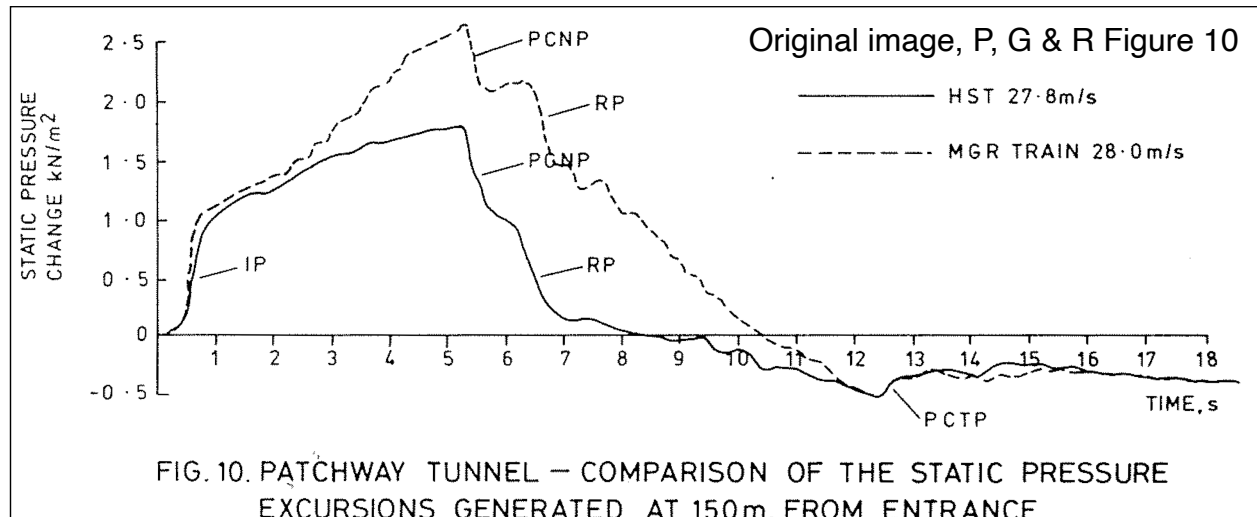Tunnel length: 1140 m, tunnel area: 22.71 m^2, tunnel perimeter: 18.19 m
HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 27.8 m/s (100.1 km/h)
MGR train: class 50(?) loco, Mk III coach and 18 coal wagons. Length 203.7 m, area 6.52 m^2, perimeter 9 m, speed 28 m/s (100.8 km/h)
Data in the image: measured static pressure 150 m from the entry portal.

Digitisation method: webplotdigitizer was given the following setting out points:
(t=0 s, P=0 Pa), (t=18 s, P=0 Pa), (t=0, P=-500 Pa) and (t=0, P=2500 Pa). It
adjusted the axes of the image to be orthogonal and digitised a set of manually
selected points. Load '1982-PGR-Fig-10.tar' into webplotdigitizer for more
details.

IP = Initial pressure rise (due to nose entry)
PCNP = Pressure change, nose passing the sensor
RP = Reflected primary wave arrives at the sensor
PCTP = Pressure change, tail passing the sensor

Comparison of the image to the digitised data

Source files: 1982-PGR-Fig-10-DP.txt and 1982-PGR-Fig-10-rotated-P.png.
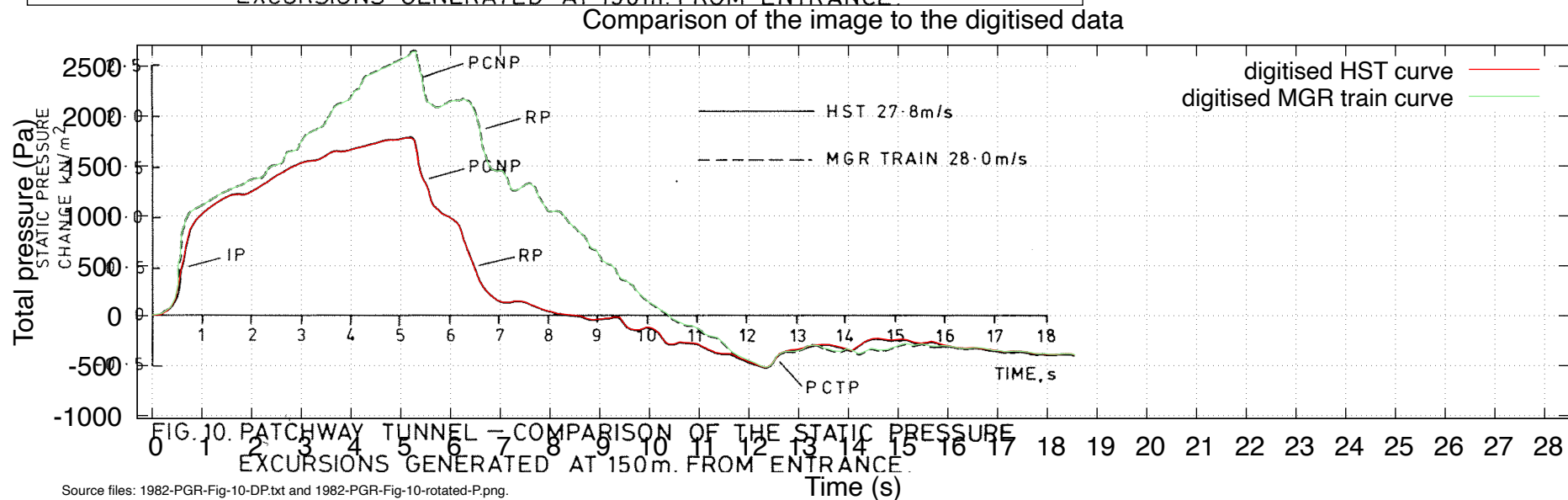
Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Middle graph on page 123

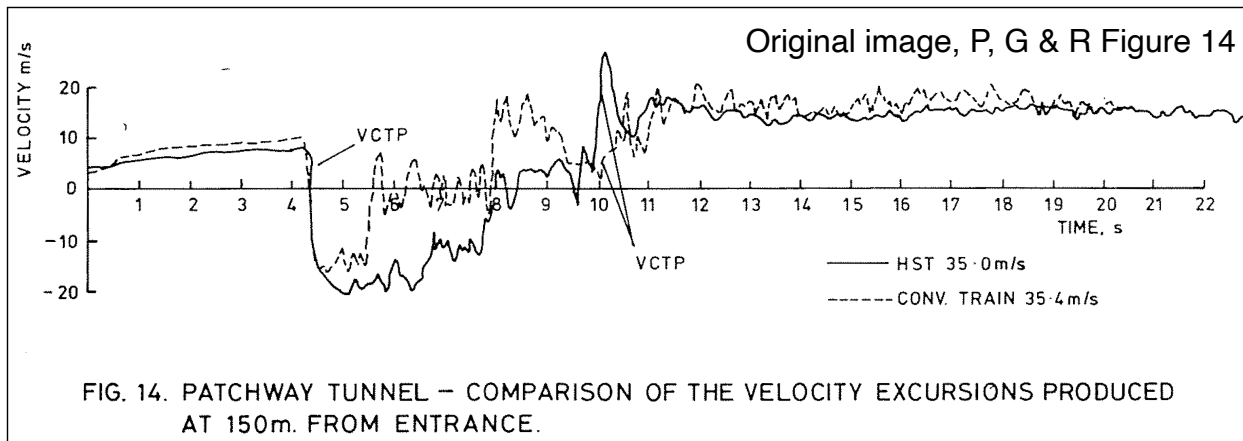Test place & time: Patchway Old tunnel (single track, no shafts), early 1980s

Tunnel length: 1140 m, tunnel area: 22.71 m^2, tunnel perimeter: 18.19 m

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 35 m/s (126 km/h)

Conventional train: 2 class 50 locomotives plus 8 MkI coaches. Length 203.2 m, area 8.2 m^2, perimeter 9.82 m, speed 35.4 m/s (127.4 km/h)
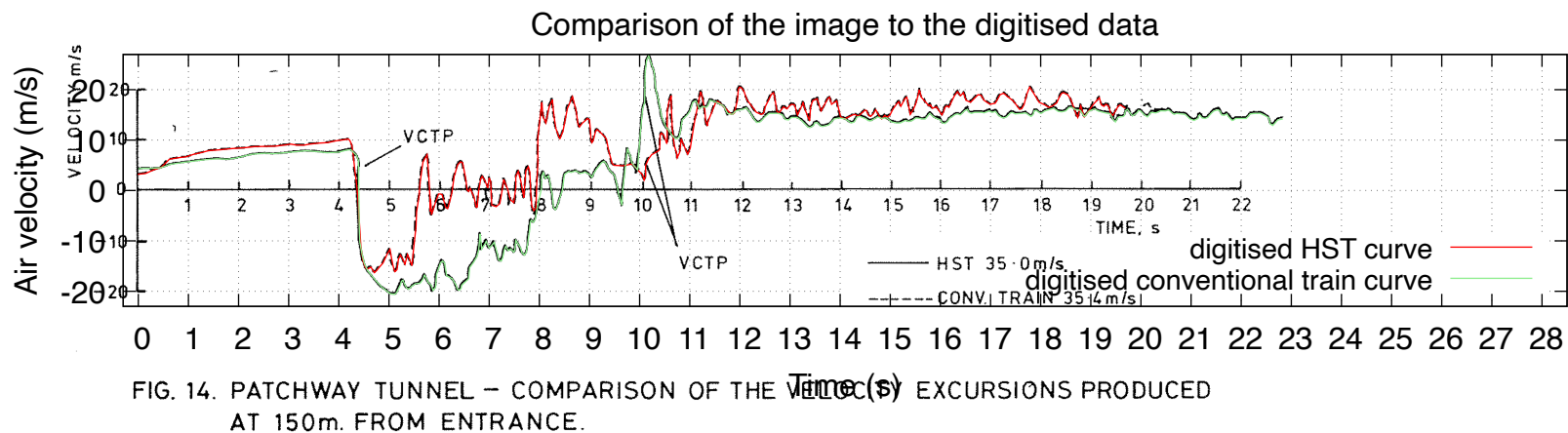
Data in the image: measured air velocity 150 m from the entry portal, 1m above track level and 0.3 m from the tunnel wall

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, v=0 m/s), (t=22 s, v=0 m/s), (t=0, v=-20 m/s) and (t=0, v=20 m/s). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-14.tar' into webplotdigitizer for more details.

Original image, P, G & R Figure 14

VCNP = Velocity change, nose passing the sensor

VCTP = Velocity change, tail passing the sensor

Comparison of the image to the digitised data

digitised HST curve

digitised conventional train curve

Source files: 1982-PGR-Fig-14-rotated-P.png and 1982-PGR-Fig-14-vel.txt.

Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Bottom graph on page 123

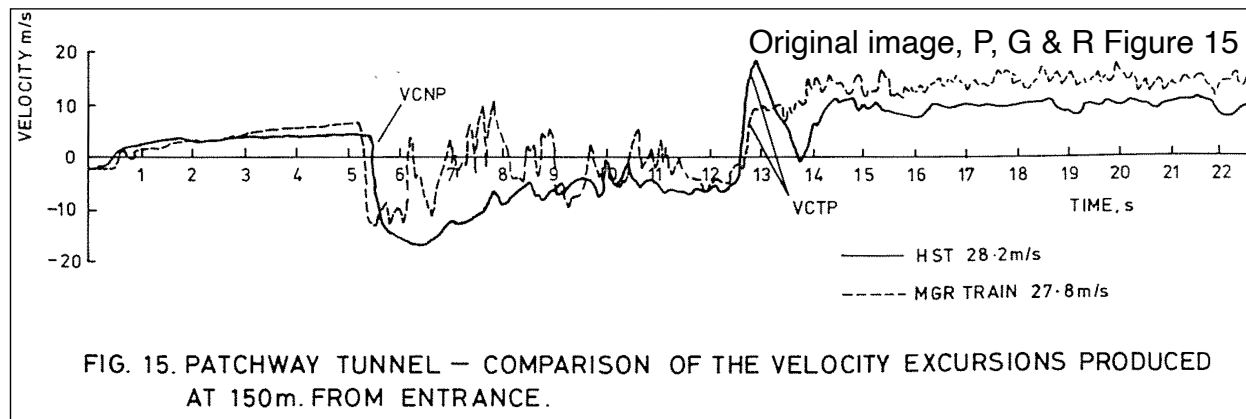Test place & time: Patchway Old tunnel (single track, no shafts), early 1980s

Tunnel length: 1140 m, tunnel area: 22.71 m^2, tunnel perimeter: 18.19 m

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 28.2 m/s (101.5 km/h)

MGR train: class 50(?) loco, Mk III coach and 18 coal wagons. Length 203.7 m, area 6.52 m^2, perimeter 9 m, speed 27.8 m/s (100.1 km/h)
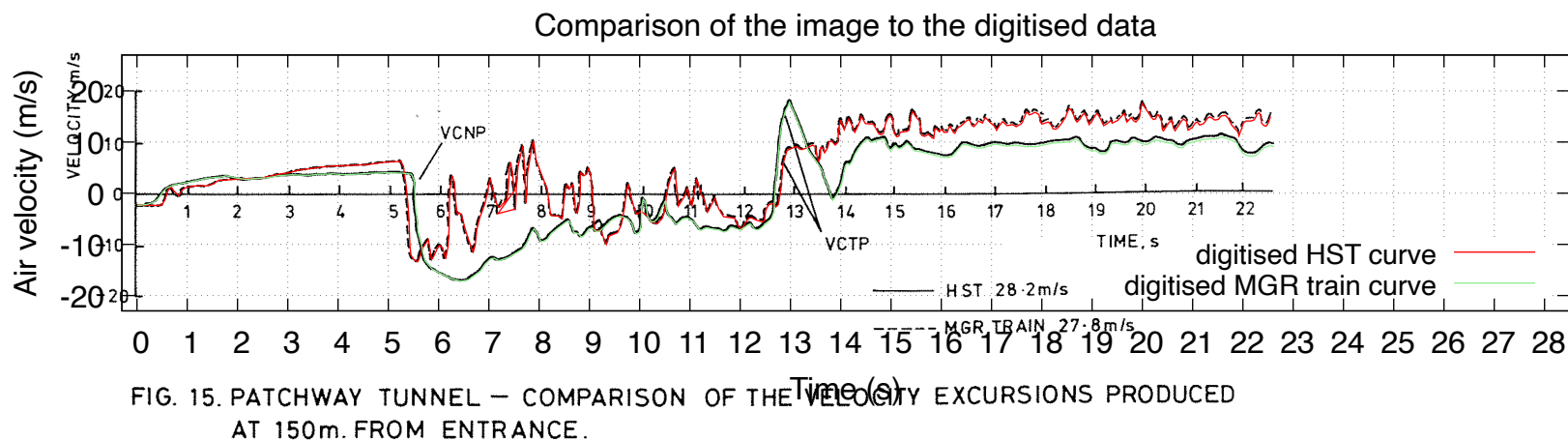
Data in the image: measured air velocity 150 m from the entry portal, 1m above track level and 0.3 m from the tunnel wall

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, v=0 m/s), (t=22 s, v=0 m/s), (t=0, v=-20 m/s) and (t=0, v=20 m/s). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-15.tar' into webplotdigitizer for more details.

Original image, P, G & R Figure 15

VCNP = Velocity change, nose passing the sensor

VCTP = Velocity change, tail passing the sensor

FIG. 15. PATCHWAY TUNNEL — COMPARISON OF THE VELOCITY EXCURSIONS PRODUCED AT 150m. FROM ENTRANCE.

Comparison of the image to the digitised data

digitised HST curve

digitised MGR train curve

FIG. 15. PATCHWAY TUNNEL — COMPARISON OF THE VELOCITY EXCURSIONS PRODUCED AT 150m. FROM ENTRANCE.

Source files: 1982-PGR-Fig-15-rotated-P.png and 1982-PGR-Fig-15-vel.txt.

Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Top graph on page 124

Test place & time: Chipping Sodbury tunnel (twin track, six shafts), early 1980s

Tunnel length: 4063 m, tunnel area: 43.8 m^2, tunnel perimeter: 24.87 m

Conventional train: 2 class 50 locomotives plus 8 MkI coaches. Length 203.2 m, area 8.2 m^2, perimeter 9.82 m, speed 44.9 m/s (161.6 km/h)

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 44.4 m/s (159.8 km/h)

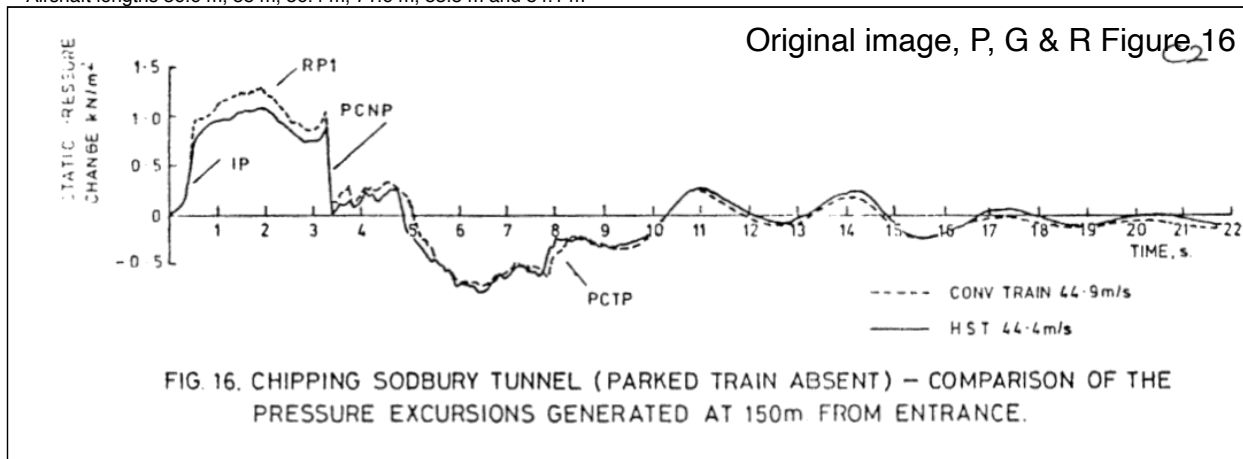Data in the image: measured static pressure 150 m from the entry portal.

Airshaft locations 422.5 m from entry portal, 1006 m, 1508.8 m, 2172.6 m, 2796.2 m and 3480.2 m

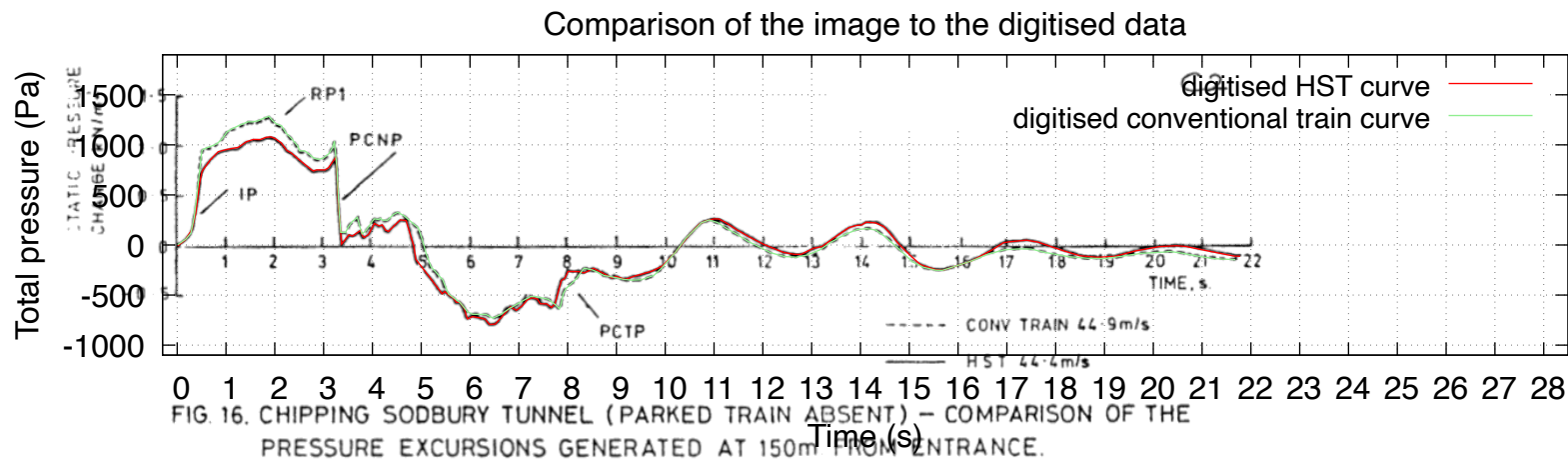Airshaft areas 10.52 m^2, perimeters 11.5 m (brick-lined construction shafts 12 feet in diameter)

Airshaft lengths 36.6 m, 58 m, 56.4 m, 71.6 m, 83.5 m and 84.1 m

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, P=0 Pa), (t=22 s, P=0 Pa), (t=0, P=-500 Pa) and (t=0, P=1500 Pa). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-16.tar' into WebPlotDigitizer for more details.

Original image, P, G & R Figure 16

FIG. 16. CHIPPING SODBURY TUNNEL (PARKED TRAIN ABSENT) — COMPARISON OF THE PRESSURE EXCURSIONS GENERATED AT 150m FROM ENTRANCE.

IP = Initial pressure rise (due to nose entry)

PCNP = Pressure change, nose passing the sensor

RP1 = Reflected wave from first shaft arrives at the sensor

PCTP = Pressure change, tail passing the sensor

Comparison of the image to the digitised data

digitised HST curve

digitised conventional train curve

FIG. 16. CHIPPING SODBURY TUNNEL (PARKED TRAIN ABSENT) — COMPARISON OF THE PRESSURE EXCURSIONS GENERATED AT 150m FROM ENTRANCE.

Source files: 1982-PGR-Fig-16-DP-PTA.txt and 1982-PGR-Fig-16-rotated-CS.png.

Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Middle graph on page 124

Test place & time: Chipping Sodbury tunnel (twin track, six shafts), early 1980s

Tunnel length: 4063 m, tunnel area: 43.8 m^2, tunnel perimeter: 24.87 m

MGR train: class 50(?) loco, Mk III coach and 18 coal wagons. Length 203.7 m, area 6.52 m^2, perimeter 9 m, speed 28.8 m/s (103.7 km/h)

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 28.5 m/s (102.6 km/h)
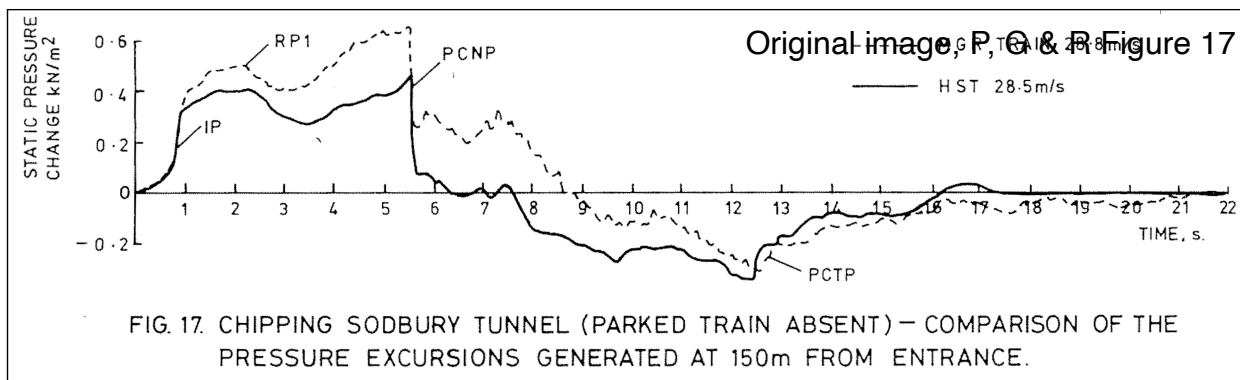
Data in the image: measured static pressure 150 m from the entry portal.

Airshaft locations 422.5 m from entry portal, 1006 m, 1508.8 m, 2172.6 m, 2796.2 m and 3480.2 m
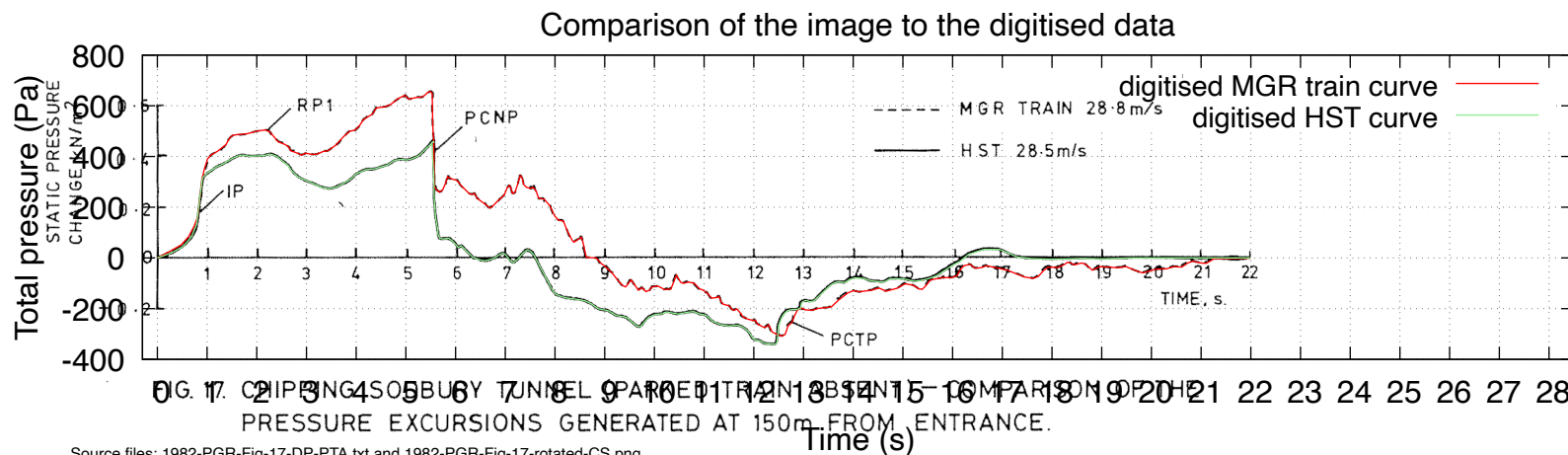
Airshaft areas 10.52 m^2, perimeters 11.5 m (brick-lined construction shafts 12 feet in diameter)

Airshaft lengths 36.6 m, 58 m, 56.4 m, 71.6 m, 83.5 m and 84.1 m

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, P=0 Pa), (t=22 s, P=0 Pa), (t=0, P=-200 Pa) and (t=0, P=600 Pa). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-17.tar' into WebPlotDigitizer for more details.

Original image, P, G & R Figure 17

FIG. 17. CHIPPING SODBURY TUNNEL (PARKED TRAIN ABSENT) — COMPARISON OF THE PRESSURE EXCURSIONS GENERATED AT 150m FROM ENTRANCE.

IP = Initial pressure rise (due to nose entry)

PCNP = Pressure change, nose passing the sensor

RP1 = Reflected wave from first shaft arrives at the sensor

PCTP = Pressure change, tail passing the sensor

Comparison of the image to the digitised data

FIG. 17. CHIPPING SODBURY TUNNEL (PARKED TRAIN ABSENT) — COMPARISON OF THE PRESSURE EXCURSIONS GENERATED AT 150m FROM ENTRANCE.

Source files: 1982-PGR-Fig-17-DP-PTA.txt and 1982-PGR-Fig-17-rotated-CS.png.

Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Top graph on page 125

Test place & time: Chipping Sodbury tunnel (twin track, six shafts), early 1980s

Tunnel length: 4063 m, tunnel area: 43.8 m^2, tunnel perimeter: 24.87 m

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 28.5 m/s (102.6 km/h)

Conventional train: 2 class 50 locomotives plus 8 MkI coaches. Length 203.2 m, area 8.2 m^2, perimeter 9.82 m, speed 29.6 m/s (106.6 km/h)

MGR train: class 50(?) loco, Mk III coach and 18 coal wagons. Length 203.7 m, area 6.52 m^2, perimeter 9 m, speed 29.2 m/s (105.1 km/h)

Data in the image: measured air velocity 150 m from the entry portal, 1m above track level and 0.3 m from the tunnel wall closest to the moving train

Airshaft locations 422.5 m from entry portal, 1006 m, 1508.8 m, 2172.6 m, 2796.2 m and 3480.2 m

Airshaft areas 10.52 m^2, perimeters 11.5 m (brick-lined construction shafts 12 feet in diameter)

Airshaft lengths 36.6 m, 58 m, 56.4 m, 71.6 m, 83.5 m and 84.1 m

Note that the Figure has a distorted Y-axis: -20 m/s to zero spans 12 mm on the page in the Proceedings, zero to 20 m/s spans 14 mm on the page.

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, v=0 m/s), (t=22 s, v=0 m/s), (t=0, v=-20 m/s) and (t=0, v=20 m/s). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-19.tar' into webplotdigitizer for more details.
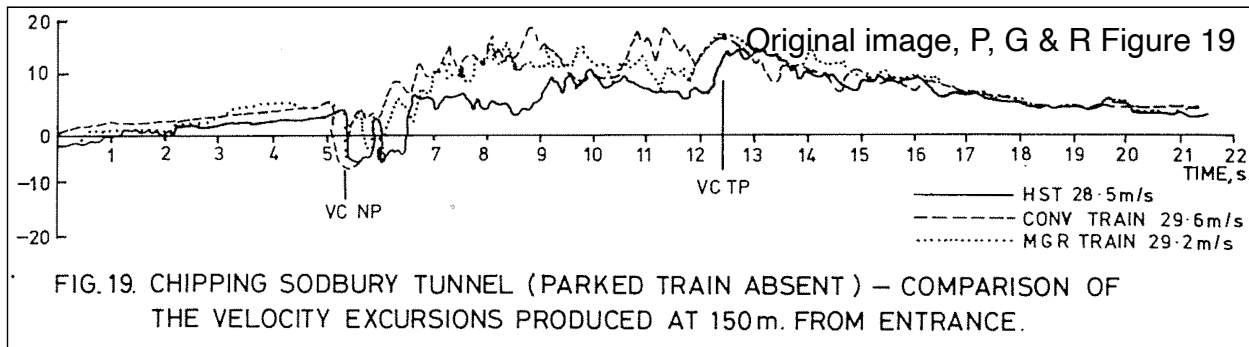
Original image, P, G & R Figure 19

VCNP = Velocity change, nose passing the sensor

VCTP = Velocity change, tail passing the sensor

Comparison of the image to the digitised data

Source files: 1982-PGR-Fig-19-rotated-CS.png and 1982-PGR-Fig-19-vel-PTA.txt.
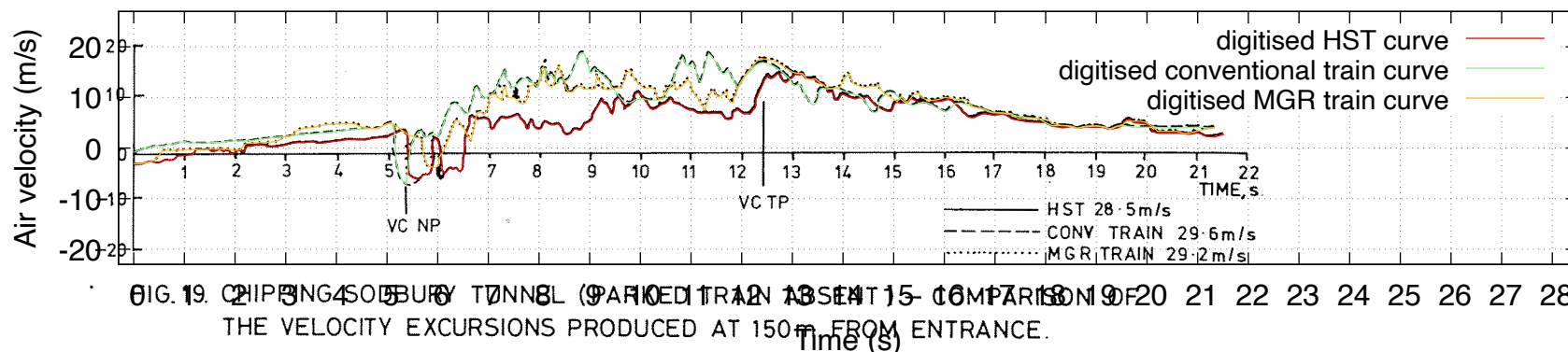
Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Second graph on page 125

Test place & time: Chipping Sodbury tunnel (twin track, six shafts), early 1980s

Tunnel length: 4063 m, tunnel area: 43.8 m^2, tunnel perimeter: 24.87 m

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 55.5 m/s (199.8 km/h)

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 55.5 m/s (199.8 km/h)

In the second test a 200 m long HST was parked just inside the entrance.

Data in the image: measured static pressure 150 m from the entry portal.

Airshaft locations 422.5 m from entry portal, 1006 m, 1508.8 m, 2172.6 m, 2796.2 m and 3480.2 m

Airshaft areas 10.52 m^2, perimeters 11.5 m (brick-lined construction shafts 12 feet in diameter)

Airshaft lengths 36.6 m, 58 m, 56.4 m, 71.6 m, 83.5 m and 84.1 m

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, P=0 Pa), (t=22 s, P=0 Pa), (t=0, P=-1500 Pa) and (t=0, P=2500 Pa). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-20.tar' into WebPlotDigitizer for more details.
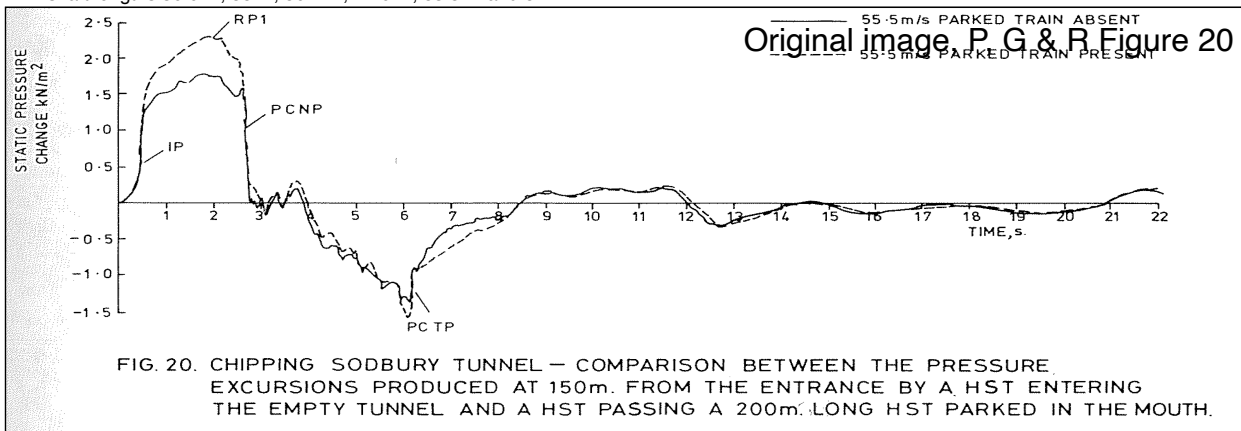
Original image, P G & R Figure 20

IP = Initial pressure rise (due to nose entry)

PCNP = Pressure change, nose passing the sensor

RP1 = Reflected wave from first shaft arrives at the sensor

PCTP = Pressure change, tail passing the sensor

Comparison of the image to the digitised data

Source files: 1982-PGR-Fig-20-DP-PTP.txt and 1982-PGR-Fig-20-rotated-CS.png.
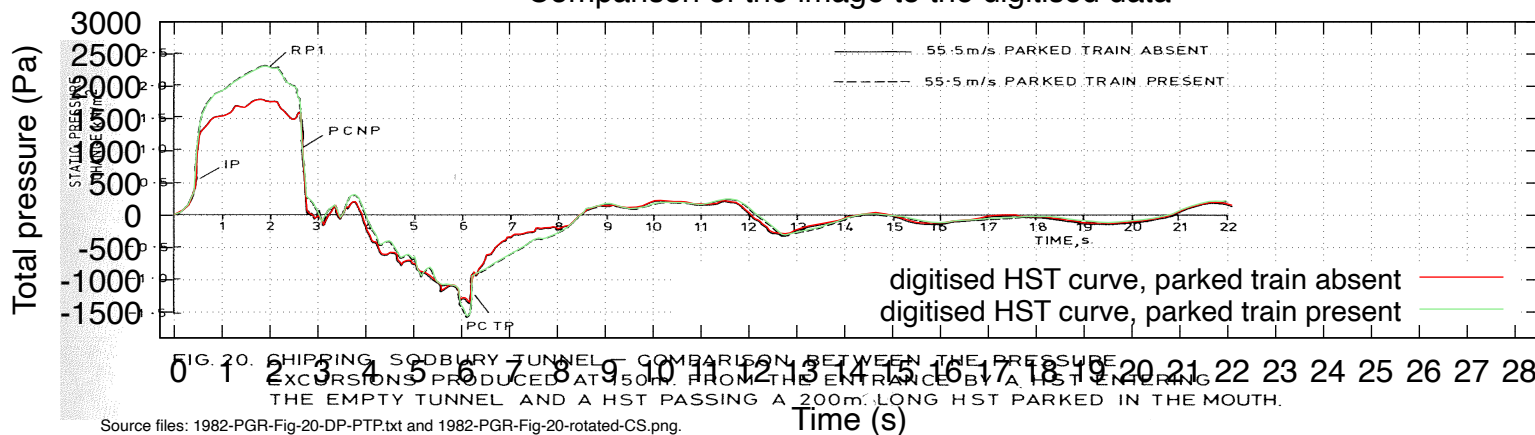
Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Third graph on page 125

Test place & time: Chipping Sodbury tunnel (twin track, six shafts), early 1980s

Tunnel length: 4063 m, tunnel area: 43.8 m^2, tunnel perimeter: 24.87 m

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 44.9 m/s (161.6 km/h)

Conventional train: 2 class 50 locomotives plus 8 MkI coaches. Length 203.2 m, area 8.2 m^2, perimeter 9.82 m, speed 44.6 m/s (160.6 km/h)

In both tests a 200 m long HST was parked just inside the entrance.

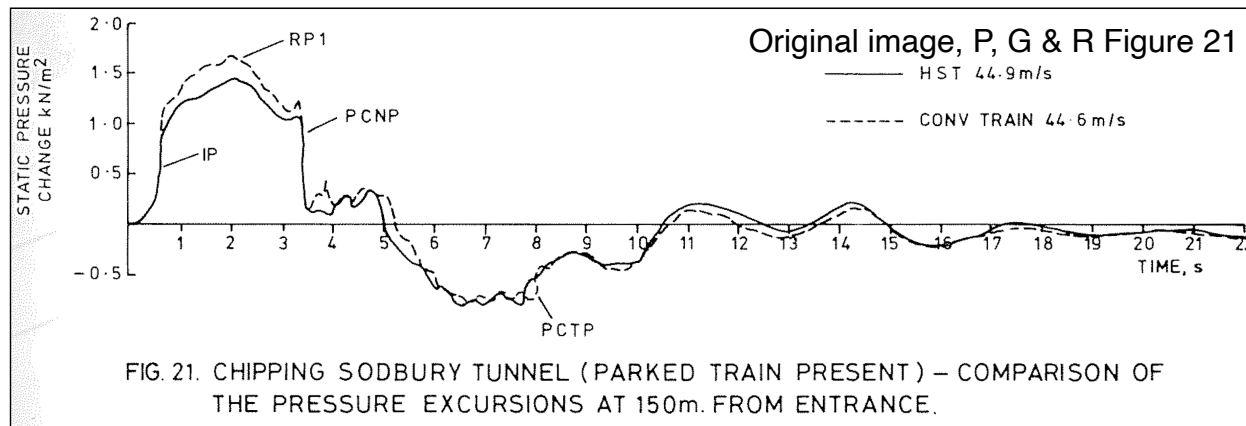Data in the image: measured static pressure 150 m from the entry portal.

Airshaft locations 422.5 m from entry portal, 1006 m, 1508.8 m, 2172.6 m, 2796.2 m and 3480.2 m

Airshaft areas 10.52 m^2, perimeters 11.5 m (brick-lined construction shafts 12 feet in diameter)

Airshaft lengths 36.6 m, 58 m, 56.4 m, 71.6 m, 83.5 m and 84.1 m

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, P=0 Pa), (t=22 s, P=0 Pa), (t=0, P=-500 Pa) and (t=0, P=2000 Pa). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-21.tar' into WebPlotDigitizer for more details.

IP = Initial pressure rise (due to nose entry)

PCNP = Pressure change, nose passing the sensor

RP1 = Reflected wave from first shaft arrives at the sensor

PCTP = Pressure change, tail passing the sensor

Comparison of the image to the digitised data

Source files: 1982-PGR-Fig-21-DP-PTP.txt and 1982-PGR-Fig-21-rotated-CS.png.
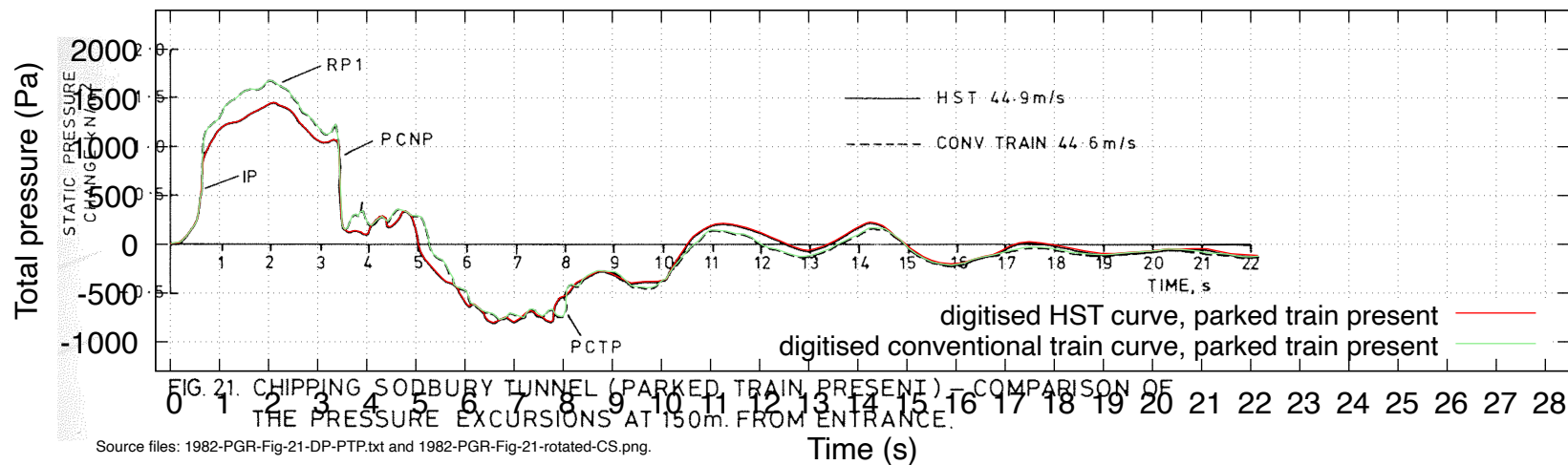
Source paper: "An experimental investigation into the effect of train shape on the unsteady flows generated in tunnels", Pope, C W, Gawthorpe R G, and Richards, S P, pages 107 to 126, Proceedings of the 4th International Symposium on the Aerodynamics and Ventilation of Vehicle Tunnels (ISAVVT), 1982.

Image source: Bottom graph on page 125

Test place & time: Chipping Sodbury tunnel (twin track, six shafts), early 1980s

Tunnel length: 4063 m, tunnel area: 43.8 m^2, tunnel perimeter: 24.87 m

HST, 2 class 43 power cars plus 7 MkIII coaches: length 196.6 m, area 9.11 m^2, perimeter 11 m, speed 28.9 m/s (104 km/h)

MGR train: class 50(?) loco, Mk III coach and 18 coal wagons. Length 203.7 m, area 6.52 m^2, perimeter 9 m, speed 28.7 m/s (103.3 km/h)

In both tests a 200 m long HST was parked just inside the entrance.

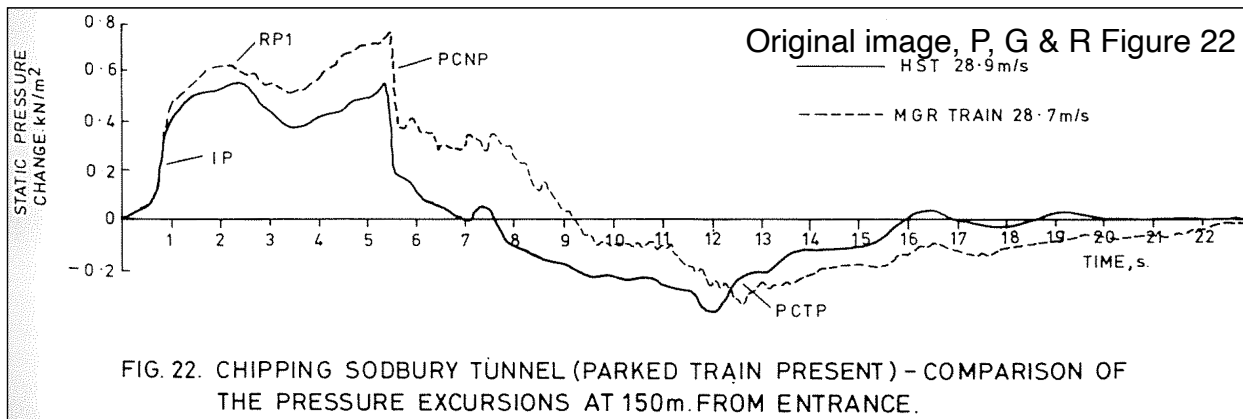Data in the image: measured static pressure 150 m from the entry portal.

Airshaft locations 422.5 m from entry portal, 1006 m, 1508.8 m, 2172.6 m, 2796.2 m and 3480.2 m

Airshaft areas 10.52 m^2, perimeters 11.5 m (brick-lined construction shafts 12 feet in diameter)

Airshaft lengths 36.6 m, 58 m, 56.4 m, 71.6 m, 83.5 m and 84.1 m

Digitisation method: webplotdigitizer was given the following setting out points: (t=0 s, P=0 Pa), (t=22 s, P=0 Pa), (t=0, P=-200 Pa) and (t=0, P=800 Pa). It adjusted the axes of the image to be orthogonal and digitised a set of manually selected points. Load '1982-PGR-Fig-22.tar' into WebPlotDigitizer for more details.

Original image, P, G & R Figure 22

FIG. 22. CHIPPING SODBURY TUNNEL (PARKED TRAIN PRESENT) – COMPARISON OF THE PRESSURE EXCURSIONS AT 150 m. FROM ENTRANCE.

IP = Initial pressure rise (due to nose entry)

PCNP = Pressure change, nose passing the sensor

RP1 = Reflected wave from first shaft arrives at the sensor

PCTP = Pressure change, tail passing the sensor

Comparison of the image to the digitised data

digitised HST curve, parked train present

digitised MGR train curve, parked train present

Source files: 1982-PGR-Fig-22-DP-PTP.txt and 1982-PGR-Fig-22-rotated-CS.png.