

Front-wheel drive

Front-wheel drive (FWD) is a form of engine/transmission layout used in motor vehicles, where the engine drives the front wheels only. Most modern front-wheel drive vehicles feature a transverse engine, rather than the conventional longitudinal engine arrangement generally found in rear-wheel drive and four-wheel drive vehicles.

Front-wheel drive arrangements

Most FWD layouts are front-engined. Historically they fall into three categories:

- Front-engine transversely-mounted / Front-wheel drive
- Front-engine longitudinally-mounted / Front-wheel drive
- Front Mid-engine / Front-wheel drive



A classic front-wheel drive car, the Citroën Traction Avant

History

Prior to 1900

According to various sources, sometime between 1895 and 1898 Gräf & Stift built a *voiturette* with a one-cylinder De Dion-Bouton engine fitted in the front of the vehicle, powering the front axle. It was thus arguably the world's first front-wheel drive automobile, but it never saw mass production, with only one copy ever made. In 1898, Latil, in France, devised a front-wheel drive system for motorising horse-drawn carts.

1900–1920

Experiments with front-wheel drive cars date to the early days of the automobile. Following the Spanish-American War, J. Walter Christie of the USA was working on designs for a front-wheel drive car, which he promoted and demonstrated by racing at various speedways in the U.S., and even competed in the Vanderbilt Cup and the French Grand Prix. In 1912 he began manufacturing a line of wheeled fire engine tractors which used his front-wheel drive system, but due to lack of sales this venture failed.

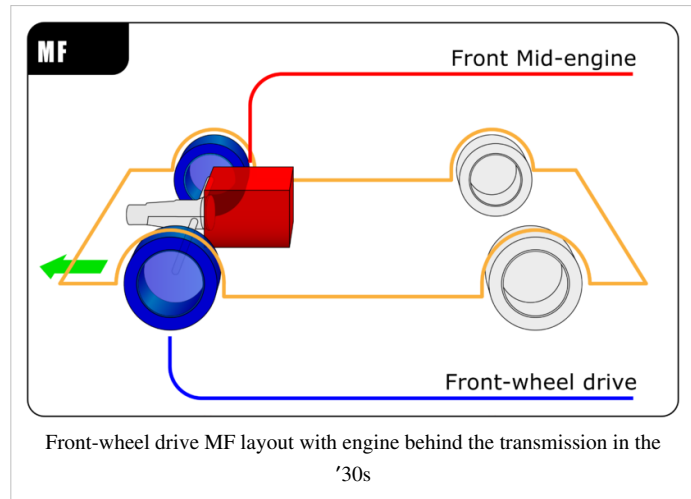
1920–1930

The first successful application of front-wheel drive was the Miller 122 racecar designed in 1924 by Harry Arminius Miller of Menomonie, Wisconsin. However, the idea languished outside of the motor racing arena as no major auto manufacturer attempted the same for production automobiles. Market experiments in the United States were left to small endeavors such as the Ruxton (200 cars in 1929), and the Cord L-29 of 1929. Neither automobile maker was particularly successful on the open market. Alvis Cars of the United Kingdom also introduced a front-wheel drive model in 1928, but it was not a success either.

1930–1945

The first successful consumer application came in 1929. The BSA (Birmingham Small Arms Company) produced the unique front wheel drive BSA three wheeler. Production continued until 1936 during which time sports and touring models were available. In 1931 the DKW F1 from Germany made its debut. Other German car producers followed: Stoeber offered a car with front wheel drive in 1931, Adler in 1932 and Audi in 1933. In 1934, the very successful Traction Avant cars were introduced by Citroën of France. The Cord 810 of the United States managed a bit

better in the late 1930s than its predecessor one decade earlier. These vehicles featured a layout that places the engine behind the transmission, running "backwards," (save for the Cord, which drove the transmission from the front of the engine). The basic front-wheel drive layout provides sharp turning, and better weight distribution creates "positive handling characteristics" due to its low polar inertia and relatively favourable weight distribution. (The heaviest component is near the centre of the car, making the main component of its moment of inertia relatively low). Another result of this design is a lengthened chassis.



1945–1960

Front-wheel drive continued with the 1948 Citroën 2CV, where the air-cooled lightweight aluminium flat twin engine was mounted ahead of the front wheels, but used Hookes type universal joint driveshaft joints, and 1955 Citroën DS, featuring the mid-engine layout. Panhard of France, DKW of Germany and Saab of Sweden offered exclusively front-wheel drive cars, starting with the 1948 Saab 92.

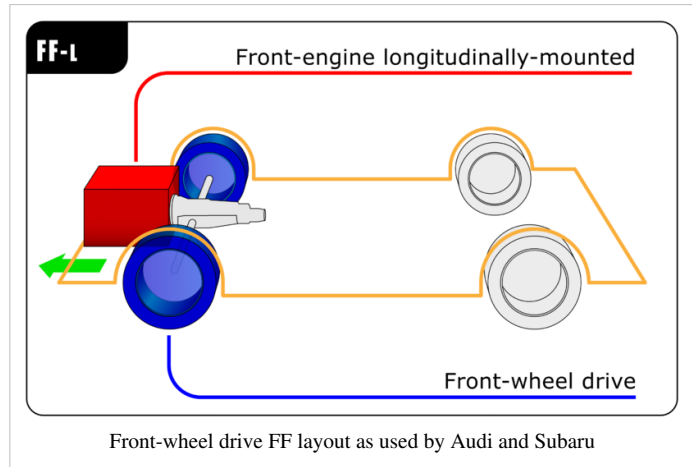
In 1946, Lloyd Cars produced the front-wheel-drive roadster, Lloyd 650. The two-stroke, two-cylinder motor was mounted transversely in the front and connected to the front wheels through four-speed synchronised gearbox. The high price and lacklustre performance had doomed its production. Only 600 units were produced from 1946 to 1950.

In 1954, Alfa-Romeo had experimented with its first front-wheel drive compact car named "33" (not related or referred to sports car similarly named "33"). It had the same transverse-mounted, forward-motor layout as the modern front-wheel drive automobiles. It even resembled the smaller version of its popular Alfa Romeo Giulia. However, due to the financial difficulties in post-war Italy, the 33 never saw the production. Had Alfa-Romeo succeed in producing 33, it would precede the Mini as the first "modern" front-wheel drive compact car.

In 1959 Austin Mini was launched by the British Motor Corporation, designed by Alec Issigonis as a response to the first 'oil crisis', the 1956 Suez Crisis, and the boom in bubble cars that followed. It was the first production front wheel drive car with a watercooled inline four cylinder engine mounted transversely. This allowed eighty percent of the floor plan for the use of passengers and luggage. The majority of modern cars use this configuration. Its progressive rate rubber sprung independent suspension, low centre of gravity, and wheel at each corner with radial tyres, gave a massive increase in grip and handling over all but the most expensive cars on the market. It used GKN designed Constant-velocity joint drive shaft universal joints.

1960–1975

The transversely mounted engine combined with front-wheel drive was popularized by the 1959 Mini; there the transmission was built into the sump of the engine, and drive was transferred to it via a set of primary gears. Another variant transmission concept was used by Simca in the 1960s keeping the engine and transmission in line, but transverse mounted and with unequal length driveshafts. This has proven itself to be the model on which almost all modern FWD vehicles are now based. Peugeot and Renault on their jointly-developed small car engine of the 1970s where the 4-cylinder block was canted over to reduce the overall height of the engine with the transmission underneath (PSA X engine). The tendency of this layout to generate unwanted transmission "whine" has seen it fall out of favour. Also, clutch changes required engine removal.

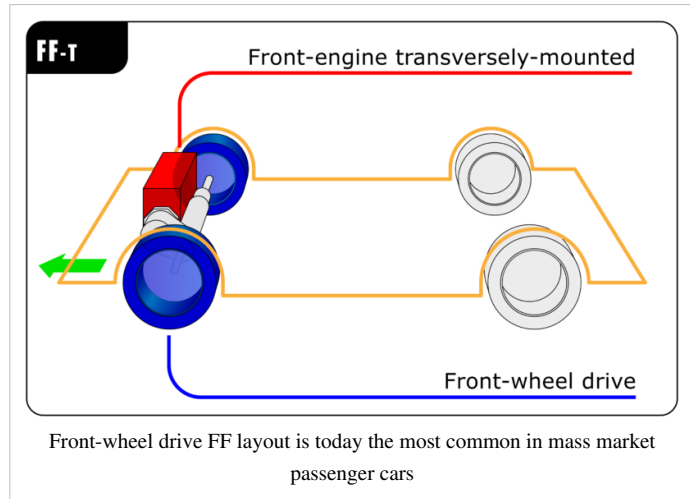


The 1965 Triumph 1300 was designed around a longitudinal engine with the transmission underneath. Audi has also used a longitudinally mounted engine overhung over the front wheels since the 1970s. Audi is one of the few manufacturers which still uses this particular configuration. It allows the use of equal-length half shafts and the easy addition of all-wheel drive, but has the disadvantage that it makes it difficult to achieve 50/50 weight distribution (although they remedy this in four-wheel drive models by mounting the gearbox at the rear of the transaxle.) The Subaru 1000 appeared in 1966 utilizing front wheel drive mated to a flat-4 engine, with the driveshafts of equal length extending from the transmission, which address some of the issues of the powertrain being somewhat complex and unbalanced in the engine compartment.

Also in the 1970s and 1980s, the Douvrin engines used in the larger Renaults (20, 21, 25 and 30) used this longitudinal "forward" layout. The first generation Saab 900, launched in 1978, also used a longitudinal engine with a transmission underneath with helical gears. The 1966 Oldsmobile Toronado was the first U.S. front-wheel drive car since the Cord 810. It used a longitudinal engine placement for its V8, coupled with an unusual "split" transmission, which turned the engine power 180 degrees. Power then went to a differential mounted to the transmission case, from which half-shafts took it to the wheels. The driveline was set fairly at centre-point of the wheels for better weight distribution, though this raised the engine, requiring lowered intake systems.

1975–1990

The Corporate Average Fuel Economy standard drove a mass changeover of cars in the U.S. to front-wheel drive. The change began in 1978, with the introduction of the first American-built transverse-engined cars, the Plymouth Horizon and Dodge Omni (based on the European designed Simca Horizon),^[1] followed by the 1980 Chevrolet Citation and numerous other vehicles. Meanwhile European car makers, that had moved to front-wheel drive decades before began to homogenize their engine arrangement only in this decade, leaving Audi (and Volkswagen) alone with the Audi front drive-longitudinal engine layout. Years before this was the most common layout in Europe, with examples like Citroen DS, Renault 12, Renault 5, Renault 25 (a Chrysler LH ancestor) Alfa Romeo 33, Volkswagen Passat, etc. This transition can be exemplified in the Renault 21 that was offered with disparate engine configurations. The 1.7 litre version featured an 'east-west' (transversely) mounted engine, but Renault had no gearbox suitable for a more powerful transverse engine: accordingly, faster versions featured longitudinally mounted (north south) engines.



By reducing drivetrain weight and space needs, vehicles could be made smaller and more efficient without sacrificing acceleration. Some suggest that the introduction of the modern Volkswagen Rabbit in 1975, from a traditional U.S. competitor, and also the Honda Civic, served as a wake-up call for the "Big Three" (only Chrysler already produced front-wheel drive vehicles in their operations outside North America). Ford's 1976 Ford Fiesta was its first front wheel drive car in Europe, GM was even later with the 1979 Vauxhall Astra/Opel Kadett. Captive imports were the US car makers initial response to the increased demand for economy cars. Front-wheel drive became the norm for mid-sized cars starting with the 1982 Chevrolet Celebrity, 1983 Dodge 600, 1985 Nissan Maxima, and the 1986 Ford Taurus. By the mid-1980s, most formerly rear-wheel drive Japanese models were front-wheel drive, and by the mid-1990s, most American brands only sold a handful of rear-wheel drive models.

1990–today

The vast majority of front-wheel drive vehicles today use a transversely mounted engine with "end-on" mounted transmission, driving the front wheels via driveshafts linked via constant velocity (CV) joints. This configuration was made popular by the 1967 Simca 1100,^[2] and the 1969 Fiat 128. The 1959 Mini, while a pioneering transverse front-wheel drive vehicle, used a substantially different arrangement with the transmission in the sump.

Volvo Cars has switched its entire lineup after the 900 series to front wheel drive. Swedish engineers at the company have said that transversely mounted engines allow for more crumple zone area in a head on collision. American auto manufacturers are now shifting larger models (such as the Chrysler 300 and most of the Cadillac lineup) back to rear-wheel drive.^{[3] [4]} There were relatively few rear-wheel drive cars marketed in North America by the early 1990s; Chrysler's car line-up was entirely front-wheel drive by 1990. GM followed suit in 1996 where its B-body line was phased out, where its sports cars (Camaro, Firebird, Corvette) were the only RWDs marketed; by the early 2000s, the Chevrolet Corvette was the only RWD car offered by Chevrolet until the introduction of the Sigma platform.

Records

- The TRD Aurion produced by Toyota Australia and tuned by Toyota Racing Development (TRD) holds the record for the most powerful mass-market front-wheel drive automobile, with 241 kilowatts (323 hp) and 400 newton metres (300 ft·lb).^[5]
- The Cadillac Eldorado, with front-wheel drive introduced in 1967, holds the record for the largest engine in a front-wheel drive production vehicle, at 8.2 L (500 in³), starting with the 1970 model, lasting until the 1976 model year.
- A production Dodge Neon SRT-4 from RaceDeck Racing broke the land speed record for its class at Bonneville Salt Flats in Utah on August 16, 2006. The record was set at 221 mph average speed for both runs on the five mile course. This is the current record for a front-wheel drive vehicle.^[6]

See also

- Automobile layout
- Rear-wheel drive
- Four-wheel drive
- FF layout
- Category:Front wheel drive sports cars

References

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- [3] "The Chrysler-Dodge LX Cars: Charger, Challenger, 300, 300C, and Magnum" (<http://www.allpar.com/cars/lx/index.html>). Allpar. .
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- [5] "Australia: Toyota Joins the Supercar Fray With TRD Aurion" (<http://web.archive.org/web/20080528182316/http://www.edmunds.com/insideline/do/News/articleId=122360>). Edmunds. 2007-08-28. Archived from the original (<http://www.edmunds.com/insideline/do/News/articleId=122360>) on 2008-05-28. . Retrieved 2007-10-12.
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