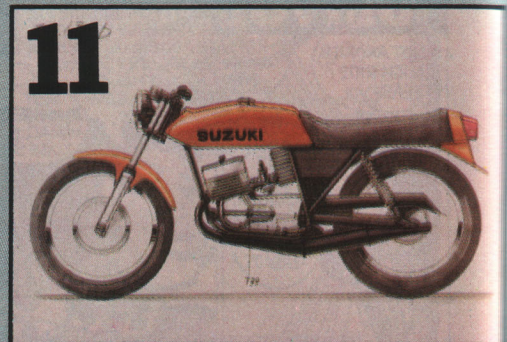
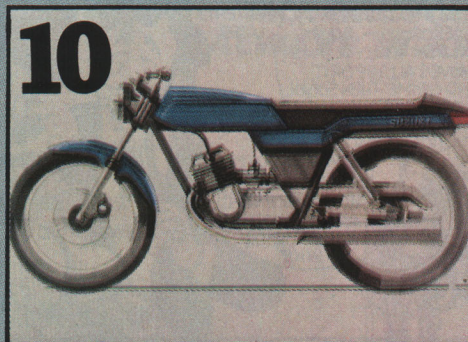
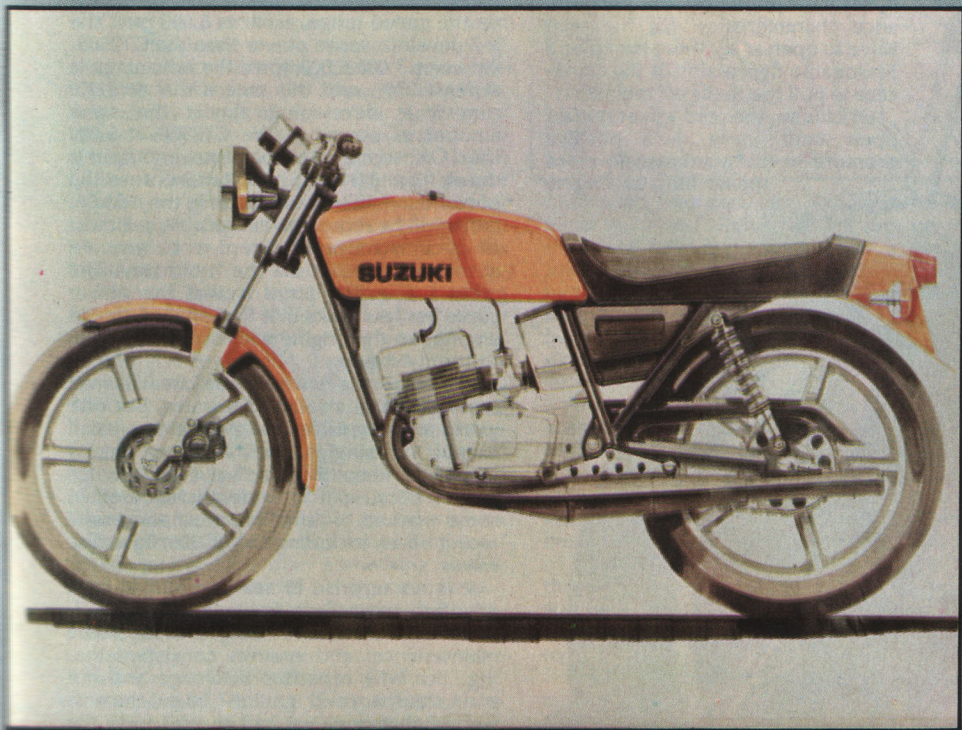
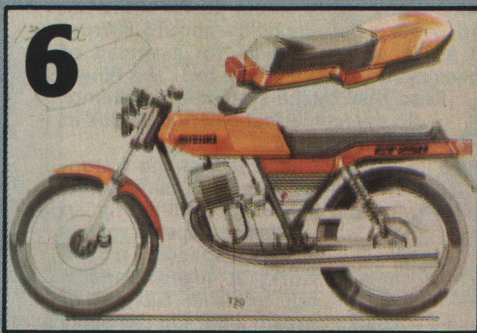
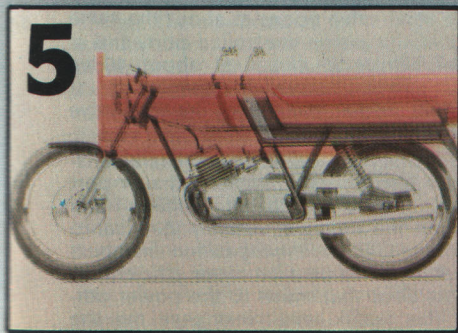
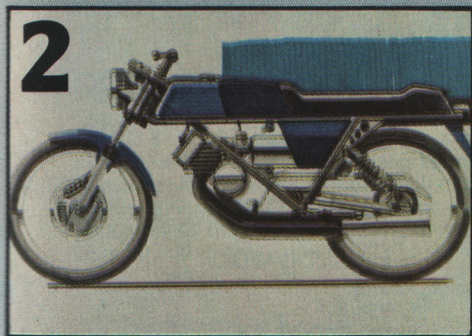


1. A monoshock chassis was considered among the early designs. 2. This triangulated, racer-like frame looks particularly light and rigid. Note the front drum brake. 3. Another early study shows the engine as a stressed member. 4 to 6. The frame becomes more conventional, with variations on seat/tank units. 7 to 9. Styling obviously emphasises sporty lines — note exhaust variations on all sketches. 10 and 11. Compare the sleek, typically Italian lines with the chunky, functional look of the near-complete machine.



Birth of the X7



John Hartley talks to the team who designed Suzuki's new 250.

And while he was there, he brought up the subjects of four-strokes (taking over the world); and, er, disc brakes (working in the wet) . . .

IF EVER there was a misnomer, it is that '100mph-250' tag being applied to the new Suzuki GT250 X-7. Not that the bike is slow, but the real feature of the design is that it gives much more medium-speed power than the old GT250, and that the peak power output has been reduced slightly — not to meet emission regulations, but to give more low-speed power.

But it isn't only the engine characteristics that are different. The bike is compact, and is very light — it weighs 25lb less than the previous GT250, and according to Suzuki, that means it has a weight advantage of at least 48lb over rival 250s, and that can't be bad.

To find out how Suzuki set about re-designing the GT250, I went to the factory at Hamamatsu in southern Japan, and met the product planners and engineers. In the company the size of Suzuki, everyone tends to be a specialist, so I spoke to over ten people, including the chief engineers for motor cycle and engine design.

To start with, they showed me the stages through which the X-7 passed from a styling point of view. As is usually the case, some of the early sketches were of real café racers, complete with clip-ons. Some had petrol tanks shaped like racers, and others featured exhausts just like plain expansion chambers. There was just one monoshock design, and I gathered that this had been rejected because the monoshock is too closely connected with Yamaha — they want to keep Suzukis looking different.

In the end, the design was watered down as indicators, mirrors, and a large headlamp were added, and as it was realised that many potential owners might be frightened away by a too-sporting appearance. After all, many 250s are bought by commuters. Interestingly enough, the painted front mudguard gave way to a chrome-plated one, because that is what Suzuki market research says people want. The smart cast aluminium wheels are also in response to 'market demand', while the production machine does retain the sporty-shaped tank and little tail found on some of the earlier sketches. The exhausts are also as near to an expansion chamber in shape as is practicable with

Birth of the X7

the need to keep the noise level down.

But why, with the trend towards four-strokes, is the X-7 a two-stroke? Kiyoshi Kushiya, chief engineer, explained that up to 250cc, the two-stroke gives much better performance, while it is lighter and cheaper to make. From 400cc upwards, Kushiya said that there was no difference between the performance of a two-stroke and a four-stroke, while emissions of the four-stroke were lower. On the 250, it is not too difficult to meet the American emission regulations for 1980, but Suzuki is currently studying ways of making very small four-strokes competitive with two-strokes.

At first sight, the fact that the new engine weighs 16lb less than the old one seems remarkable. After all, the same materials are used, and it is still an air-cooled twin with the same 54 x 54mm dimensions. But, of course, the old 250 was designed as both a 250 and a 350, so the cylinder spacing was quite generous, while the gears had to be able to take about 40% more torque than the new model. Therefore, the new engine, which is 14in wide and 13.6in high, is altogether more compact than the old one

— especially in the gearbox, which is a good deal narrower. So, the new engine/gearbox weighs only 81 lb compared with 97 lb for the old one.

The layout of the engine is simple enough, with the crankcases split on the axis of the crankshaft and gear shafts, and the alternator on the left-hand end of the crankshaft. On the alternator rotor is the pick-up for the CD ignition system. There is a gear primary drive to the clutch on the right-hand side of the engine, while the six-speed gearbox is straightforward.

But apart from its low weight, what makes the X-7 engine new is its dual porting, which is already used on the Suzuki off-road machines and on the GT50 sold in Japan. Suzuki call the system 'Power-Reed dual intake', and although it has many advantages, it is not patented at all. Basically, there is the conventional inlet port whose opening and closure is controlled by the piston. In addition, there is another port opening into the crankcase just below and behind the cylinder which has a reed valve. Thus, the inlet port forks into two parts in the cylinder barrel.

The object of the exercise is to give power low down with good peak power — normally, if you go for all-out power at the top end, there is nothing below about 5,000rpm on a 250, and if you go for a spread of power, you lose out at the top. The Power Reed dual intake system is an attempt to overcome that basic fact of life in engine design.

The idea is that the piston-controlled port is fairly small, and has fairly 'mild' timing, so it gives good performance at low speeds. It still works at higher speeds, but tends to run out of breath a bit. On the other hand, at low speeds, the reed valve hardly opens at all, so it has little effect on the performance characteristics. For the reed valve to open at all, there has to be a reasonable depression in the crankcase to pull the reeds off their seats.

Of course, the reed valves remain open until there is a positive pressure in the crankcase to close them. But, as engine

speed increases, so the inertia of the column of gas passing through the reed valves increases. In other words, there is a column of gas moving into the crankcase, and the gas at the back tends to push that at the front. The effect of this is that as the speed increases, so the reed valve remains open longer.

So how does this all work out on the X-7? Well, the main difference is that the inlet opening period of the piston controlled port is about 16 degrees less than on the GT250B. The actual timing of the ports on the two engines is:

Inlet timing: GT250 X-7
64deg BTDC to 64deg ATDC
GT250B
74deg BTDC to 74deg ATDC

Transfer port timing:
GT250 X-7
59deg BBDC/ABDC
GT250B
60deg BBDC/ABDC

Exhaust timing:
GT250 X-7
89deg BBDC/ABDC
GT250B
90 deg BBDC/ABDC

The reed valve opens at about the same point as the piston controlled port, and at 6,000-7,000rpm it closes at about 60deg ATDC. Peak power is developed at 8,000rpm, and at that speed, the reed valve closes at around 70deg ATDC.

Of course, the performance characteristics are also affected by the exhaust port timing and the exhaust system, and although the timing is virtually identical to that of the GT250B, the expansion chambers are reckoned to be a bit more efficient.

What does that mean to the power output? The Suzuki engineers gave me the power curves, and the shape of these is much more realistic than those pretty curves you see in the catalogues. All the way up the speed range, as far as 8,000 rpm, the X-7 develops more power than the GT250B. Between 3,000-6,000 rpm, the advantage is at least 23%, and this means that at 5,000 rpm it is developing almost the same amount of power as the GT250B at 6,000 rpm. OK, so the actual peak power output is down from 31 to 29 bhp, but because the power curve is so much fatter in the middle, there will be more power available in almost all circumstances — except when you are absolutely flat out on the motorway. The other interesting point is that the power curve has less kinks in it than that of the old engine, so the engine will respond quicker to the twist-grip.

In a sense, the Power-Reed system has the same effect as a rotary disc valve. But disc valves are expensive, and awkward to install except on singles. For all that, Suzuki intend to keep the disc valve on the 125 single, because it is evidently favoured in some markets — after all, most successful racing bikes, including the RG500, have disc valves.

It is no surprise to see that Suzuki have adopted contactless ignition for the X-7, since this eliminates the need for some maintenance, and ensures consistent timing. But why capacitor discharge and not plain transistorised ignition? To get the answer to that one, we had to wait until the ignition specialist arrived, and he explained that it was purely a case of the energy



available at high speeds. With transistorised ignition, in which the conventional inductive coil is used, the energy available at the plug falls off from about 5,000 rpm. On a two-stroke, the equivalent speed is only 2,500 rpm, since sparks are required twice as often, so at high speeds there is not too much current available. On the other hand, with the CD ignition system, there are 30 kV available right up to maximum engine speed. Of course, the system is very simple as well.

For the X-7, Suzuki have altered all the gear ratios slightly, internal ratios now being 2.5, 1.63, 1.21, 1.0, 0.86 and 0.783:1. The effect of these changes has been to reduce the gap between first and second, while increasing the other gaps slightly. This should result in a more useful second speed, and less of a lurch on the first-second shift. One worthwhile small change in the gearbox is the arrangement of the kick-start so that the engine can be started in gear. And that operation will now be easier anyway, as the kick-start is on the right.

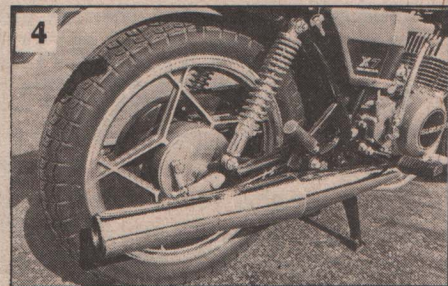
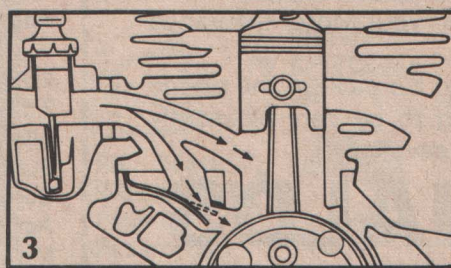
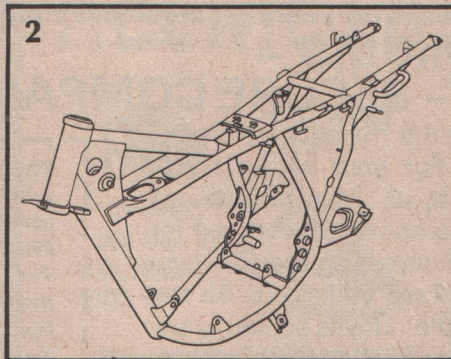
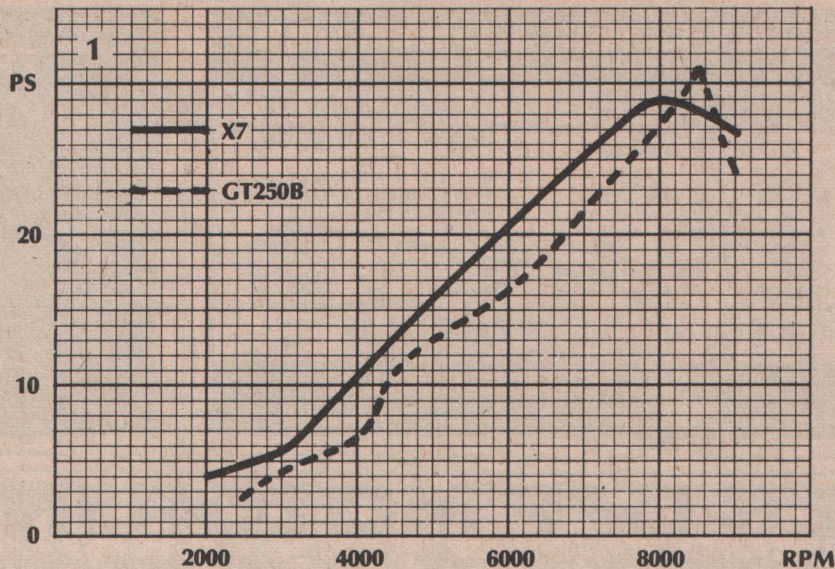
When it came to the chassis, the Suzuki engineers concentrated on reducing weight. Therefore, they adopted a single-downtube frame to replace the duplex design. The downtube is 1.68 in diameter by 0.08 in thick, compared with two 1.1 in diameter by 0.09 in thick tubes. The steering head is well gusseted, and there are two top tubes, so the complete frame is light — 3 lb lighter than the old one, at 26 lb — and stiff. Overall, then, the X-7 must be rated an all-round improvement over the GT250B. It's lighter, it has a wider spread of power, many detail improvements, and it also looks quite a machine. But what about fuel consumption? Well, the Suzuki engineers are hoping that the weight reduction will help, but myself I'm very doubtful. There's only one thing that will improve the fuel consumption of a small two-stroke, and that is a completely new scavenge and fuel system.

Over the past 18 months or so, Suzuki have introduced a very impressive range of four-strokes, from the GS400 up to the GS1000, and I took the opportunity of asking about some of the main features of these engines. Why, for example, did Suzuki go for twin ohc even on the GS400, where Yamaha have shown that a single ohc layout can give just as good performance? The Suzuki engineers said that the market demanded twin ohc, and anyway, it was easier to get the power that way.

But why keep to a ball and roller bearing crankshaft layout? Whereas I expected the engineers to answer that this arrangement would give longer life, I received the reply that it was cheaper to make the crankshafts this way, although the lower noise level and smaller size of plain bearings were recognised as advantages. I found that a bit surprising, but it does show that once a factory gets geared up for a method of manufacture it is difficult to introduce new ideas, simply because most innovations cost more to produce than something similar that is being produced in large numbers.

And what about four-valve heads? Here, the Suzuki engineers were non-committal, other than to comment that a four-valve head was very expensive to produce.

Incidentally, Suzuki have modified the GS400 for this year to improve performance, and the changes amount to new inlet and exhaust camshafts, and a transverse pipe



1: The power curves show that the X-7 engine develops much more low-speed power than the superceded GT250-B.

2: The new frame has a single downtube, but looks fairly stiff. Needle roller bearings are used at the swinging arm pivots

3: Key to the new engine is the 'Power Reed' dual inlet ports, in which the piston controlled port gives good low-speed performance, and the reed valve top-end power

4: Finalised exhaust system — close to expansion box plus silencing cans.

linking the two exhausts. The valve lift has been increased slightly, to 7.8 mm on the inlet, and 8.2 mm on the exhaust, while the inlet valve timing only has been altered to increase the valve opening period. The new timing, with the old timing in brackets, is: Inlet opens 34 (30) deg before TDC, and closes 76 (70) deg after BDC, giving a further 10 deg of opening.

Another new model from Suzuki that is attracting a lot of interest is the SP370, which in fact replaces the TS400 sold in the U.S.A. It was introduced basically because there were problems in meeting emission regulations with the two-stroke engine, and also because Suzuki think that riders of this type of machine want four-strokes. Incidentally, the SP370 is very oversquare at 85 x 65 mm, and the Suzuki people admitted that we can expect to see an SP250, which will still be oversquare, in the not too distant future.

But what about the wet-weather performance of Suzuki disc brakes, which I personally have found to be poor, and which have come in for a lot of criticism from road testers? To start with, I was told that it was

only in Britain that these discs had been criticised. Of course, we know that the Americans tend to ride only when the sun shines, but surely people ride in the wet in Japan? It had rained solidly throughout the Sunday before I visited Suzuki, and I'm told that during the rainy season, from the middle of June to the end of July, it rains almost every day.

Well, no, I was told, the Japanese don't ride much in the wet! Anyway, the Suzuki engineers said, we compared our bikes with those of the competition, and found that ours were no worse. Be that as it may, at the end of last year, Suzuki introduced some new pads on the front discs of all models, and they have also developed a new material for rear pads. This has been fitted to the GS750 for a little while now.

Which just goes to show that the Japanese manufacturers do take notice of criticism, even if they pretend that things are better than they really are. And that, coupled with the intense competition there is between the different Japanese manufacturers must be good for motor cyclists.