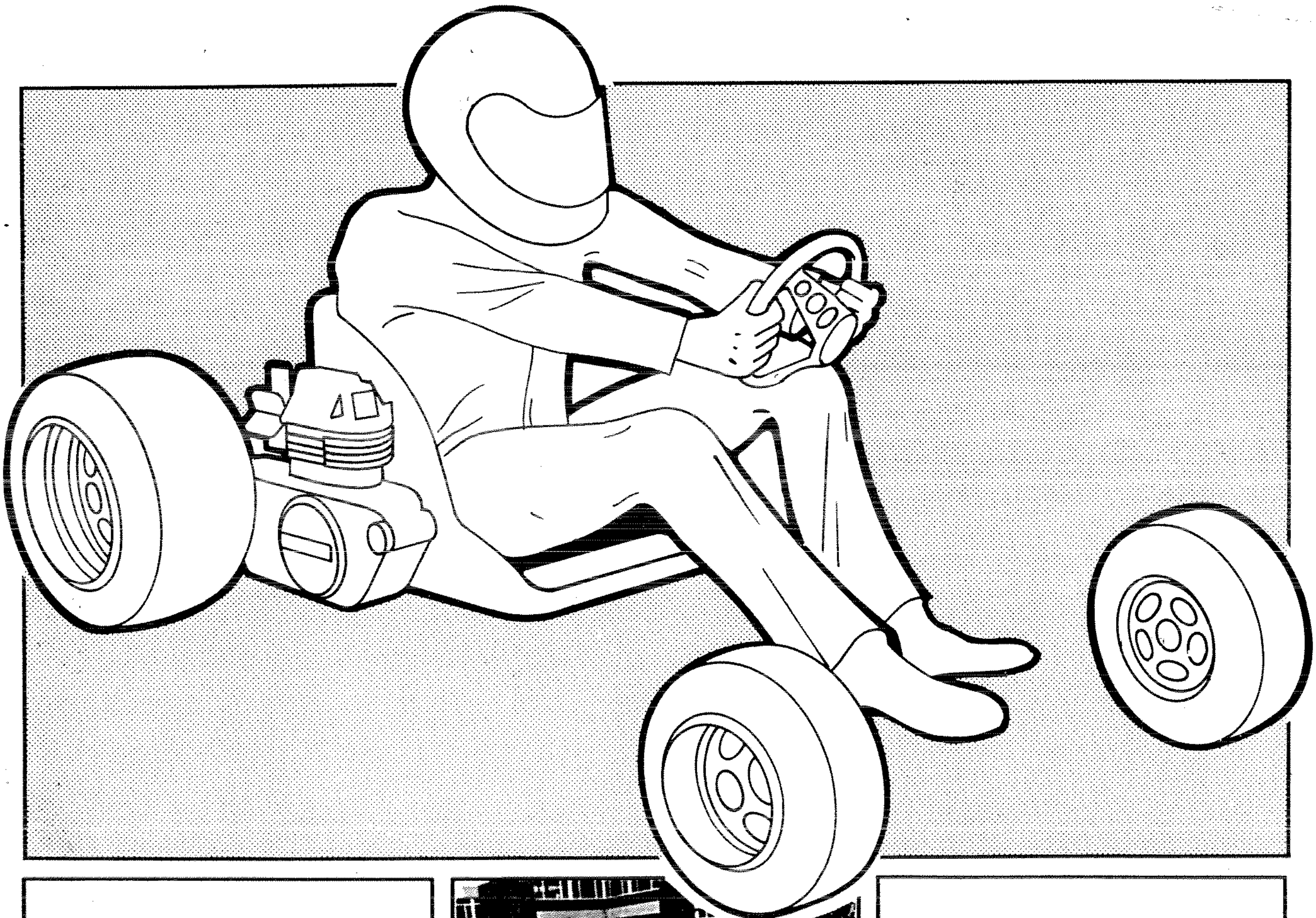
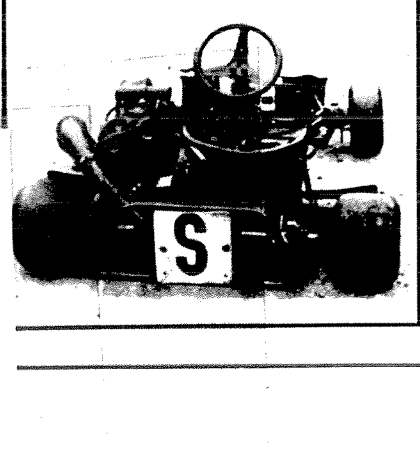
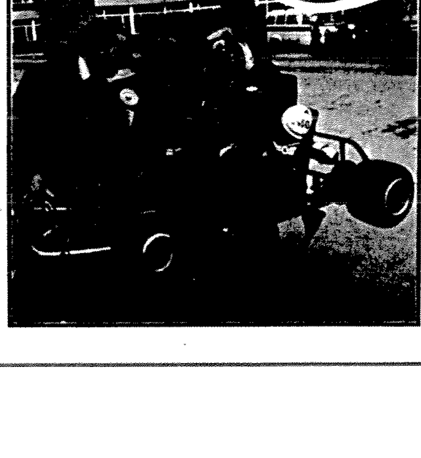
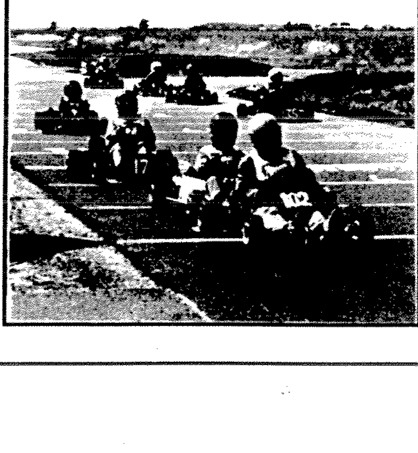
Castrol EDUCATIONAL DIVISION

THE NatSKA GUIDE TO KARTS AND KARTING









Mechanisms

It is in this field that a kart is so valuable, for its mechanism is such a perfect visual aid, especially in connection with levers, and inclined planes. We see levers in the form of pedals, and steering linkages, inclined planes in the form of screws and cams in the braking systems.

Transmission of motion, mechanical advantage, and velocity ratios are all practically illustrated by the chain drive. You can also show how the alteration of gearing, even only by a single tooth in one sprocket, can have a significant effect on the performance of the kart.

Now, down to practical concepts of kart design:

Chassis shapes

Early karts were built to two principal configurations — those with ladder frames, and those with space frames. The former used heavier section tubing, but space frame tubing was usually of much lighter section.

Fig. 1
SPACE FRAME

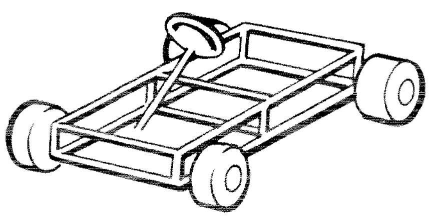
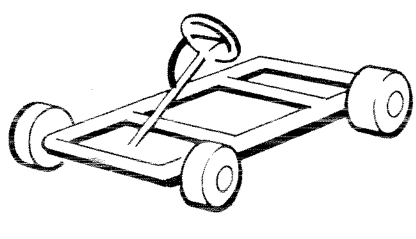


Fig. 2
LADDER FRAME



However, it has been found that ladder frames tend to flex more than space frames, were thought to have more potential, and are now used by most professional kart-building companies.

A summary of Regulations

These are the regulations which must be followed when the design of a new NatSKA-type kart is considered.

The chassis should be adequately strong and safe, must not include any temporary components, and should comply with the following:

Wheelbase:
Minimum 101cm
Maximum 127cm

Length:
Maximum overall length 182cm

Tracks:
Must be a minimum of ⅔rd the chosen wheelbase, up to a maximum of 114cm

Height:
Maximum 60cm, without driver on board

Wheels & Tyres:
Wheels must have bearings, and tyres must be pneumatic. Minimum wheel diameter 22.2cm, maximum 44.1cm

Bodywork:
May not extend behind the back bumper. There must be nothing above the driver's limbs. Maximum height 50cm. Must be of sound construction

Bumpers (Back and front):
Must not extend sideways beyond the inner rims of the wheels

— full details are printed in NatSKA Regulations printed at the back of this book.

The design requirement

The chassis has to be laid out, within the given regulations, so that the kart can be cornered quickly, but without undesirable handling characteristics, and must be both safe and durable.

Materials required

Professionally built chassis use 1⅛in. × 14 SWG seamless steel tubing. Cheaper chassis use the same size tubing, but the less expensive ERW tubing.

Most schools chassis, however, tend to use 1⅛in. × 16 SWG ERW tubing.

For low-powered and lightweight karts (50cc single-speed machines, for example) either use 1in. × 16 SWG ERW tubing, or 1in. × ½in. × 16 SWG rectangular tube.

Steering hoops and bumpers are best made from ½in., ¾in. or 1in. tubing.

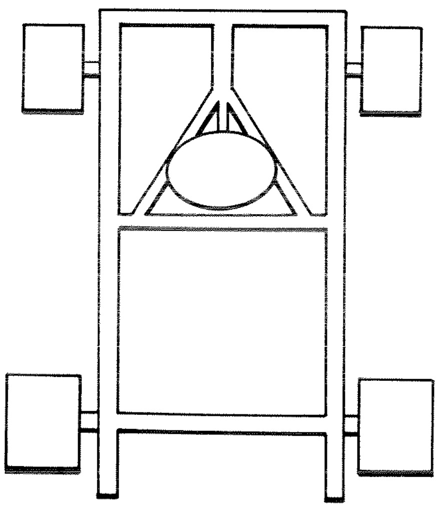
Plywood, if used, should be 18mm thickness, marine quality.

Design theory

Unlike cars, karts do not have suspension, and wheels that move relative to the frame. Accordingly, to help keep all four wheels on the ground, the kart's frame must twist while cornering. The design of the frame is complicated by the fact that twist is not desirable in certain areas (such as that part between the engine and the rear, driven, axle — which could mean that the driving chain jumped off the sprockets).

If the chassis was rectangular, as in this sketch:

Fig. 3

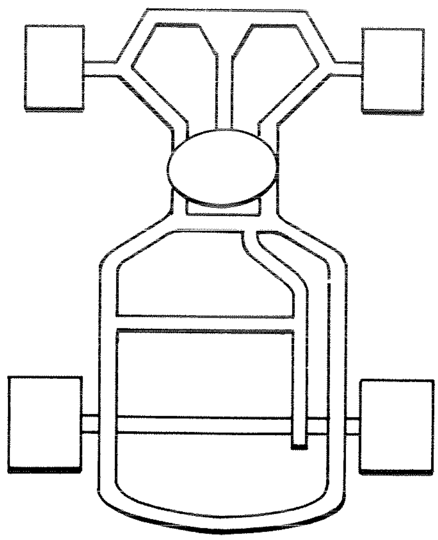


— twist would take place across the diagonals. The seat would tend to twist, and cornering would be uneven because the engine would tend to hold one side rigid while the other side flexed.

Examples

Since the late 1960s, most kart builders have tended to adopt a frame having a rigid seat/engine/rear end, with the centre of the frame 'waisted in', to allow this twist to take place, and the front of the frame being splayed out once again, to allow space for the driver's feet, and to provide adequate support for the front wheels and the steering:

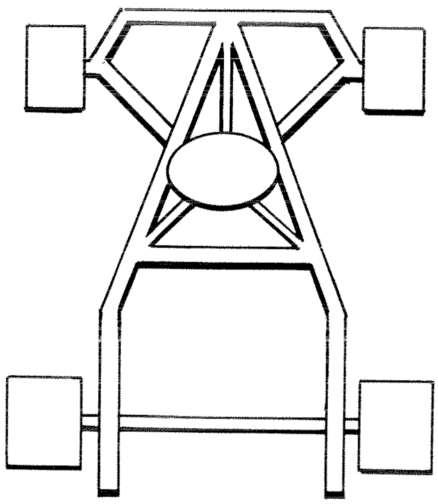
Fig. 4



The actual arrangement of side rails, and cross members, varies from maker to maker, though the general principle is usually the same.

From time to time, designers have experimented with an 'A-frame' configuration:

Fig. 5

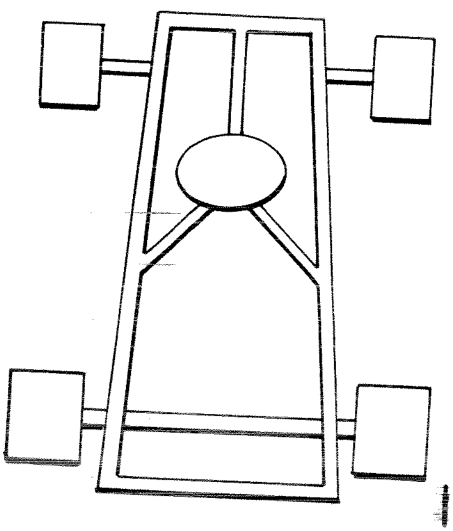


— these seem to be back in favour in the early 1980s. Early models seemed to handle well at low speeds on tight corners, but tended to 'hop' on fast corners. The NatSKA 100 model built on these lines was perhaps a little bit too rigid, and had a tendency to understeer. The basic principle, however, is very sound, and it might even be rather easier to build. It could well provide scope for future development.

Materials

At this point it is appropriate to consider the use of materials other than steel. Although it might sound unlikely at first, we can confirm that many successful schools karts have had their chassis built from 18mm thick marine quality plywood. The basic shape chosen has remained unchanged, and because of its uniform twisting qualities, such a frame has very tolerant handling qualities:

Fig. 6



Two disadvantages, however, are that this type of frame tends to be heavy, and more easily damaged, or broken, than steel. However, it is easy to construct, and easy to repair.

Some designers have even made experiments in monocoque construction, by using $1\frac{1}{2}$mm or 3mm ply, and filling the space between sheets with expanded polyurethane foam. These can look very effective, and give the appearance of a tiny sports car, but they tend to be too rigid, and eventually begin to break up after constant use. Here, perhaps, is a whole new area for experiments to take place, which might include the use of torsional suspension, and perhaps redesign to feature a central backbone spine?

A final possibility is that shown in the general layout of single-bend chassis, outlined in the next chapter. There are many different possibilities with this type of construction, and purely as an example we show alternatives:

Fig. 7

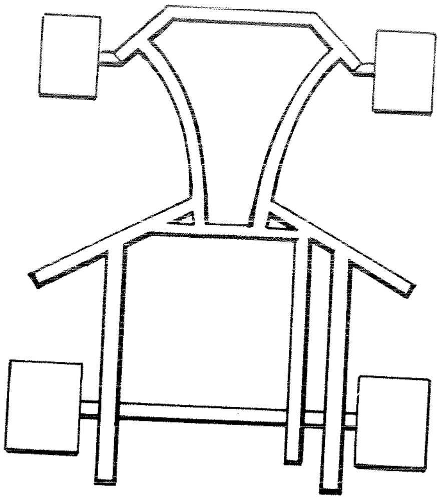
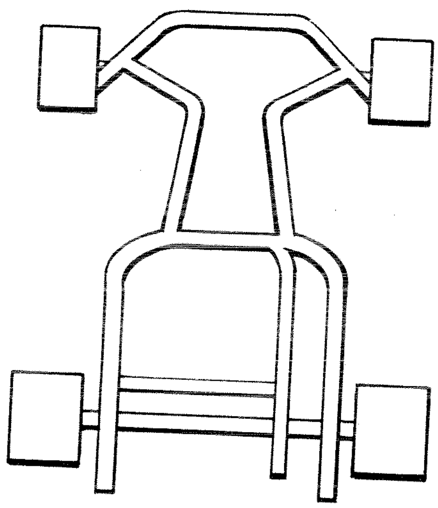


Fig. 8



It is important that too much strain is not placed on the centre joints, as these could obviously become the weak points. However, this layout does lend itself to easy construction, there is a narrow waistline to provide the necessary flexing, and there are always excellent opportunities for future development.

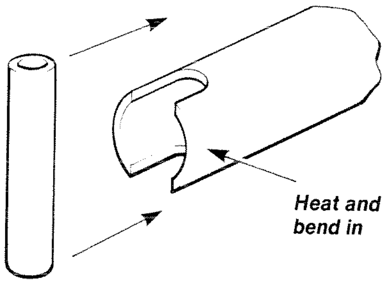
Constructional hints

No matter what method of kart construction is chosen, it is always important to adhere to good basic principles.

Make sure that all joints are a good tight fit. You should never rely on weld or braze to fill in holes, and to provide strength. At one time it was generally felt that chassis frames should be assembled by bronze welding (as this could flex without breaking), but it is now usual for modern chassis simply to be welded together — by arc or acetylene methods — with no apparent ill effects. Remember that if bronze welding is chosen, that you should always check for blackness around the weld, for this indicates poor penetration.

Above all, take special care with the fastening of king pin posts to the frame, for if one of these breaks off there can be disastrous consequences, the kart could overturn, and the driver be thrown out. When using the conventional method, with a yoke on the stub axle:

Fig. 9



— mouth out the open end of the chassis, so that it fits snugly around the king pin post, giving support for it, as well as providing a large welding area. If the post is of a similar diameter than the chassis cross rail (this is most likely to be the case), heat up the end of the chassis, and bend it inwards to touch the post, even before you begin welding together.

Should you choose to use adjustable steering, make the Rose joint holding posts from some very substantial angle iron, and use it to protect the Rose joints — otherwise each knock to a front wheel might damage the Rose joint, and prove costly and time consuming.

Be sure to read the bumper regulations very carefully, and make those on your own kart very substantial. This is especially important on a beginner's kart, where the pupils might tend to show more enthusiasm and commitment than skill!

When the construction is completed, consider what the frame should look like. The finish of a chassis will make or break the overall effect, for other people will only see it as an object. Good handling and flashing performance will somehow not be as impressive with a scruffy kart, so be sure to prepare, and paint it, properly. Two part epoxy paints are probably the best for this purpose, but they really need to be applied with a spray gun. In the other hand, reasonable results can be obtained by using brush-applied Humbrol enamel paints.

Purely for appearance's sake, for smartness, it is always nice to have front and rear bumpers, steering column and pedals, all chrome plated, but this may not be possible if you have only limited finances. However, as the next section makes clear, most schools can solicit help from a local engineering company for this sort of detail improvement.

Safety Aspects

The following recommendation cannot be made too strongly:

TEST YOUR KART VERY CAREFULLY BEFORE USING IT

Check each weld, and each dimension. Be ruthless when checking that every joint is sound, for it will be punished unmercifully on the race track. It is not enough merely to point out that drivers should take care not to break something.

You should check the chassis for flexing, by putting the completed frame, with wheels, on to the floor, and lifting one wheel at a time. This is only a rough and ready guide, but each front wheel should be able to be lifted to the same height as the other, before any of the other wheels begins to leave the ground.

If this is not the case, then you must make adjustment, which at first sight appears crude, to rectify the matter. The best way involves the use of volunteer pupils to stand on the rear of the frame, the putting of a tool box or solid mass under the wheel which is not lifting far enough, then jumping hard on the other wheel to twist the chassis:

Fig. 10

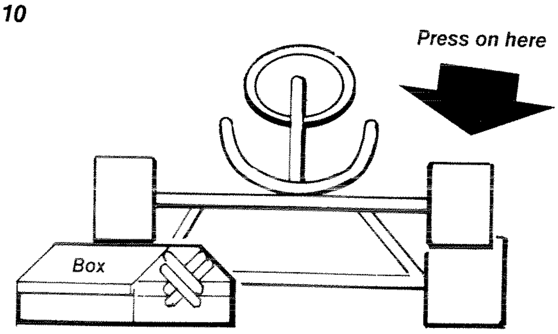


Fig. 11