A Chapel On Wheels

Architectural Effects in Rolling Stock

By M. M. Hunting

THE Catholic Church Extension Society has just put into service one of the handsomest and in many respects the most unique chapel cars ever built. It is the first car of the kind ever used by a Catholic organization for church purposes, and is being sent out to neglected portions of the country such as mining communities, lumber camps and the like.

An unusually prominent feature of the interior is the similarity of furnishings and scheme of architecture to that of some of the large churches and cathedrals. This is especially noticeable in the manner in which the various emblems and symbols of the church have been incorporated in carving and design of the woodwork and decorations.

While on a less extensive scale, the equipment is as complete in essential details as a modern church edifice. The interior is finished in a carefully selected and rich appearing mahogany, the ceiling being executed in a handsome shade of dark green with simple but appropriate decorations.

The metal fixtures and hardware are of statuary bronze and a further elegant effect is given by the artistic patterns of art glass upper sashes of the windows and the ventilators.

The old Gothic type of architecture has been carried

out in the design of the furnishings and gives dignified and imposing appearance to the interior which one would hardly expect in so small a structure.

On a platform elevated six inches above the main floor of the auditorium is the sanctuary and altar. These are equipped with the usual furnishings and ornaments, while trap doors in the platform conceal a storage space for literature and other supplies which the car will carry.

Between the sanctuary and the auditorium is located a communion railing, above and in conjunction with which has been built a rood screen of scroll work after the fashion of the English cathedrals. Upon this is mounted the rood or cross, the whole structure forming a sort of screen in front of the altar and making it possible to shut off this space from the auditorium by means of curtains when the car is stationary.

On the altar proper is placed the tabernacle, the door of which is elaborately decorated with carving, while above this is placed a handsome marble crucifix. The tabernacle contains the sacred documents of the church and such other materials as are regularly used in church services.

There are two small steps on either side of the tabernacle for the reception of candlesticks, urns and other

ornaments, and the altar is equipped below with drawers for vestments and other supplies.

At one side of the altar on the raised platform of the sanctuary is located the confessional.

A kneeling bench extending the full width of the car is placed in front of the communion railing, and shorter steps for the same purpose are placed in front of each pew. These are arranged so that they may be raised under the pew when not in use.

On the piers between the double windows in the auditorium, and let into the side finish, are placed framed photographs of famous oil paintings illustrating the stations of the cross.

An organ designed and built especially for the car is placed near the entrance to the chapel at the observation end of the car together with a combination organ stool and music cabinet.

In the auditorium are several berths for the accommodation of a portion of the party who will accompany the car, while at the opposite end beyond the altar are located the private apartments for the superintendent of the car. These consist of a study furnished with a book-case, table, chairs, etc., a state room and shower bath. The study also serves as a dining room for all who accompany the car, and there

Raised Platform With Altar and Sanctuary.

The Study in the Superintendent's Apartment.

is a complete kitchen with a range and all the necessary cooking utensils at the front end of the car.

There are numerous lockers in different parts of the car, toilet facilities and every convenience that one would find on the best-equipped parlor car.

The exterior is painted a dark green with the name of the society appearing in gold leaf on the letter board, and the name of the car "Saint Peter" with the society's coat of arms in colors on the sides.

The car is 74 feet 10½ inches in length, and is very

substantially constructed, having a built-up structural steel under-frame, steel super-structure and steel exterior.

The exterior plates are ½ inch steel, and the roof is of the standard shape and covered with copper.

The car is well insulated throughout to insure the greatest comfort in varying temperatures. It has a vestibule platform at one end and an observation platform at the other, six-wheel trucks and air brakes.

The interior is lighted with acetylene gas, which is

generated by a plant on the car. There is, of course, the usual steam heat system.

Many other modern improvements and safety devices have been added which make the car complete in every detail and well prepared for the work to which it will be assigned.

The chapel car was built and dedicated in Dayton, Ohio, and started on its first trip June 29th. It is said to have cost twenty thousand dollars, and the society feels that the money has been well invested.

Elements of Theoretical Aeromechanics*

Part II Concluded.—Aerodynamics

By A. F. Zahm, Ph.D.

Concluded from SUPPLEMENT, July 27, 1912, Page 51

Results of Higher Analysis.—We now have touched lightly on some of the most elementary topics in the extensive, not to say formidable, science of fluid dynamics. Fortunately, they are also among the most interesting topics, and the most valuable for practical use. By the aid of analytical machinery, too elaborate for the scope of this work, other principles and conclusions may be derived, at once entertaining and important when duly applied. But it will be sufficient merely to state, without proof, some well-established theorems on the flow and resistance of a perfect fluid about various familiar geometrical forms.

Fig. 1.—Stream-lines About a Sphere Moving Through a Frictionless, Incompressible Infinite Fluid.

In general it may be said that a frictionless incompressible fluid of infinite extent, flowing steadily and irrotationally past a body of whatever shape, encounters no resistance, and exerts no resultant pressure upon the body, but presses it equally on both front and rear. This is true not only of fair shaped objects, like the torpedo and the two-edged sword, but of angular and flat forms as well, such as the cube and normal plane. The proposition has been affirmed also of natural fluids flowing past objects of easy shape, by certain well-known writers, assuming the surface friction of such bodies to be negligible. But the proposition is untrue in theory, and disproved by experiment. Theory shows that no viscous fluid can flow without resistance past any geometric solid, even though perfectly smooth; and experiment shows that all such bodies offer both head resistance and skin-friction. It is evident without computation that viscous fluids must encounter some resistance in flowing about solids, however smooth, because the stream-lines crowd each other, and adjacent fluid filaments run at different speeds, thus generating internal friction and consuming energy, which can be ascribed only to the resultant pressure of the immersed object. It may be inferred, however, that when the motion is so extremely slow that the frictional effect is negligible the viscous fluid behaves sensibly like a perfect one.

Another general theorem asserts that when the above hypothecated frictionless fluid moves past a solid with accelerated speed, or when the solid moves with ac-

* Abstracted from the author's treatise on aeromechanics, reproduced from the *Journal of the Franklin Institute*.

Fig. 4.—Stream-lines of a Frictionless, Incompressible Infinite Fluid Flowing Past a Stationary Sphere.

celerated speed through the quiescent fluid, there is always a resistance, and this is directly proportional to the acceleration. Commonly the fluid resistance, in accelerated motion, can be expressed by merely endowing the moving object with a certain additional mass, and writing its impulsive resistance equal to the product of this additional mass multiplied by its acceleration; entirely ignoring the pressure of the fluid. For a sphere the additive mass is half that of the displaced fluid; for a circular disk moving normally it is slightly over five eighths of the fluid mass displaced by a sphere of equal diameter; for a circular cylinder

Fig. 2.—Stream-lines About a Circular Disk Moving Through a Frictionless, Incompressible Infinite Fluid.

moving transversely it is exactly the mass of the fluid displaced; for an elliptic cylinder it is the same as for a circular one whose diameter equals the major or minor axis, which ever is placed transversely to the line of motion. In each case the additive mass of the moving object multiplied by the acceleration gives the fluid resistance; but, of course, to find the whole resistance to acceleration, due to the inertia of both the body and the medium, the mass of the body itself must be combined with the fictitious additive mass, which latter represents only the equivalent of fluid resistance. For example, the resistance of a sphere is $(m+m')j$, in which m is the mass of the sphere, m' is half the mass of the fluid displaced, and j is the acceleration of the moving sphere.

Enough has been said to show that the equivalent inertia of a solid accelerating through a fluid is very material, if its density and that of the fluid are at all comparable. Due account of this fact, therefore, should be taken, in studying the resistance of natural fluids in unsteady motion, or of objects accelerating through such fluids. Unfortunately, this is not always done, even by fastidious experimentalists.

The stream-lines of the hypothetical fluid under consideration, as it flows steadily past opposing objects, have been determined mathematically for various

Fig. 5.—Stream-lines of Frictionless, Incompressible Infinite Fluid Flowing Transversely Past a Circular Cylinder.

geometrical forms, and graphically outlined for a number of interesting cases. Figs. 1, 2, and 3 represent, respectively, the stream-lines round a sphere, a circular disk, and a circular cylinder of infinite length, each moving through the fluid. The stream-lines for limpid natural fluids are of similar character, except in the immediate rear of the moving objects, where a turbulent wake occurs, and at sharp turns and angles which produce eddies on the sides and rear. Also it may be noted that for elastic fluids the maximum deflection of the outer stream-lines cannot occur opposite the widest section of the obstacle, but occurs farther to the rear, some time being required to carry the impulse outward. This will be seen in the stream-line figures obtained experimentally.

The theoretical stream-lines for a sphere, a circular

Fig. 3.—Stream-lines About a Long Circular Cylinder Moving Transversely Through a Frictionless, Incompressible Infinite Fluid.

cylinder, and an inclined plane, each held stationary in the medium, are shown in Figs. 4, 5, and 6. In both front and rear of each there is a median stream-line abutting squarely upon it at the point of greatest pressure, and separating the main parts of the current. For the inclined plane the points of abutment are not, in general, at the centers of pressure, but nearer the edges than these are. Needless to say that the resultant pressure is in front of the center of surface, so that an inclined plane tends to set itself squarely to the current, if pivoted at the center of surface.

DYNAMICS OF VISCOUS FLUIDS.

The general equations of motion of a viscous fluid have the same form as those representing the motion of a frictionless fluid, except for the addition of terms involving the co-efficient of viscosity. This co-efficient represents a physical quantity which has been accurately determined for many fluids by exact measurement. It is sometimes also termed the co-efficient of internal friction. When the velocity varies from stratum to stratum in a viscous fluid, the unit shearing stress on the face of any thin lamina taken parallel to the flow, varies directly as the fluid velocity gradient taken squarely across the lamina. The ratio of this stress to the gradient is called the co-efficient of viscosity. In other words, the shearing stress in a viscous fluid is proportional to the rate of shearing strain, and the factor of proportionality is called the co-efficient of viscosity.

In a perfect fluid moving without compression no

Fig. 6.—Stream-lines of a Frictionless, Incompressible Infinite Fluid Flowing Past an Inclined Plane.