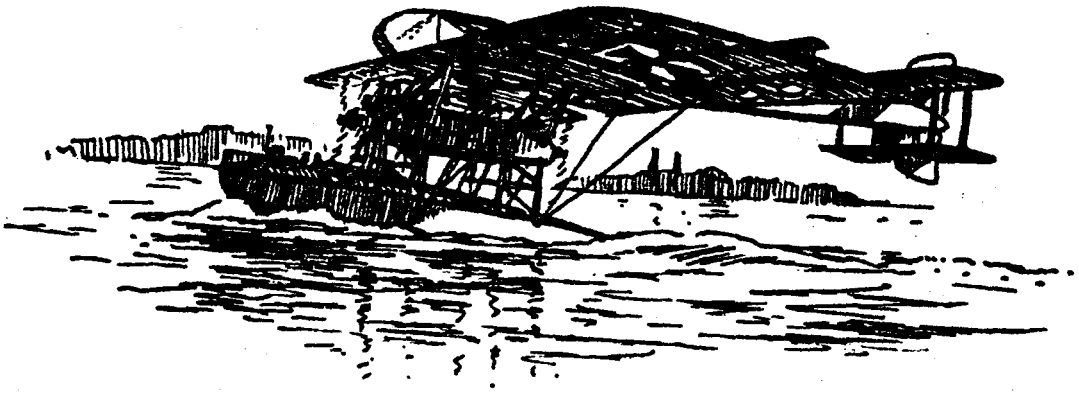
# Dornier - Man of Vision



N.J. Forrester

In the comparatively short history of aviation, a very large number of pioneers have added to the cumulative knowledge representing the state of the art at any moment. Most of this progress has been by patient and logical development of current theories of structure and aerodynamics.

Few indeed were those, whose inner vision caused them to desert well-trodden paths and, led only by faith, struck off into largely unexplored fields. Such a man was Claudius Dornier.

In the early days of aviation, the relative ease and cheapness of fabric covered wooden-framed structures caused the universal adoption of this method. Its suitability to the light, low-powered aircraft of the period was enhanced by other qualities. Ease of repair, and likewise modification, were welcome assets in the "cut-and-try" era.

Even if metal construction had been seriously considered, lack of experience, lack of suitable light alloys and to a large extent lack of leadership inhibited its adoption. Only Breguet in France produced anything like a reasonable solution, and his aircraft were unable to match the performance of the "stick and rag" brigade.

During World War 1 no significant change in the situation took place. Ease of production was of prime importance. Most factories could, and did, supplement trained woodworking staff with carpenters and joiners, and in addition could easily train non-skilled persons in simple woodworking tasks.

Such, then, was the position in the early years of World War I, although this situation led to difficulties towards the end of the conflict, when a critical

shortage of first class timber was to occur.

It took, therefore, men of considerable tenacity to introduce metal construction for aircraft. Their theories were often received with as much enthusiasm as were those of the pioneers of iron and steel ships many years earlier.

An early pioneer in the use of metal construction was, oddly enough, the Luft Schiffbau Zeppelin Company. In 1910 there joined this company a young engineer named Claudius Dornier. Perhaps more than any other, his theory and developed practice of metal construction was to influence post-war aviation.

Naturally enough, Dornier's early experience was with lighter-than-air craft, but his thoughts soon turned to the application of the light alloy construction to conventional aircraft. His theories and oft-stated confidence in the future of metal aircraft soon attracted the attention of his employers.

Largely due to Dornier's influence, the Zeppelin-Werke Lindau GmbH was founded in 1914 to explore the application of metal construction to large flying boats. This far-sighted policy on the part of Count von Zeppelin was not intended to produce aircraft in large numbers. The magnitude of the task was clearly realised, and the primary aim was to thoroughly explore the problems attending the design and construction of large, metal-structured aircraft.

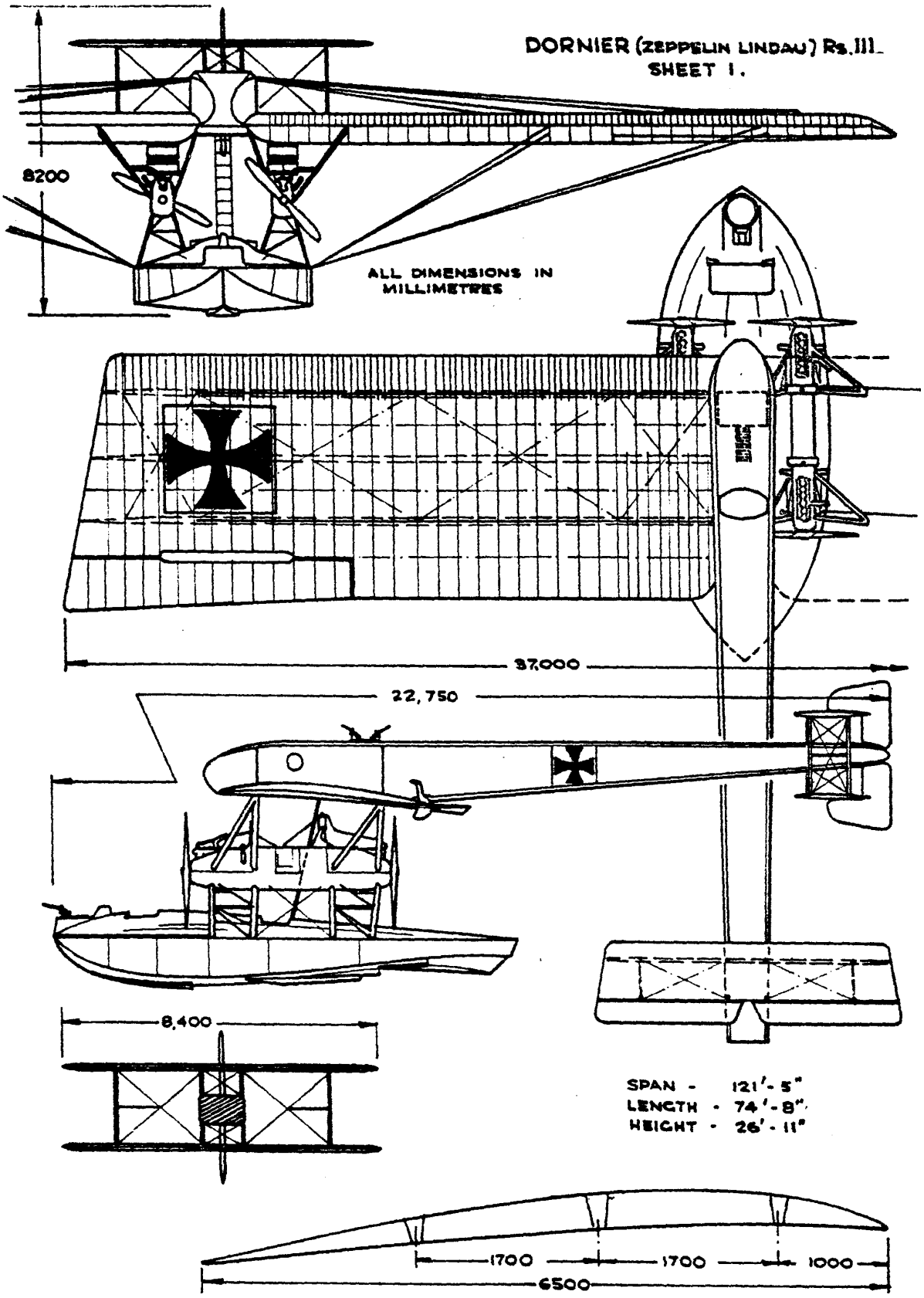
The first design by Dornier's small team emerged in 1914. A huge flying boat 142' 9" (43.5 m) in span, and 95' 1½" (29.0 m) long, it was of biplane construction and conventional layout. A considerable amount of the framework used owed much to Zeppelin L.T.A. practice, some of these methods having been perfected by Dornier himself for a projected trans-Atlantic airship.

The construction of the Rs.I was by itself a considerable achievement and had engines of sufficient power been available the aircraft might have been a success. However, the installation of three 240 H.P. Maybach Motors was totally inadequate. It is certain that the Rs.I made numerous taxying trials and according to at least one source, may even have flown. The description of these flights, true or false, indicates that the aircraft's lifting ability, if any, owed much to ground effect. In the event, after minor mishaps, the Rs.I was totally wrecked at its moorings during a severe gale.

It was obvious that the basic design philosophy was correct and capable of development. Approval was readily forthcoming for continuation of the programme.

The next flying boat, the Rs.II, emerged in 1915. A smaller machine than the Rs.I, its dimensions were 108' 11" (33.2 m) span and length 78" 4" (23.BS m). Power was again. supplied by three 240 H.P. Maybach engines. Although in the

# DORNIER (ZEPPELIN LINDAU) Rs.III.
SHEET 1.



Rs.II, airframe construction was beginning to shake off L.T.A. influence, a curious reversal to airship practice saw the installation of the engines within the hull. It is apparent that the shaft-and-bevel gear transmission must have induced some power loss, negating to some extent the saving in airframe weight. Three pusher propellers were fitted.

A broad, boat-type hull supported biplane wings, from which sprouted a very inadequate-looking empennage on a boom structure. Little imagination is required to guess that directional stability was to be a primary problem.

Performance of the Rs.II appeared promising, but failure of the transmission system resulted in a forced landing and considerable damage. Never one to neglect an opportunity, Dornier rebuilt the Rs.II, correcting most of its early shortcomings. Power was increased by addition of a fourth engine, and all engines were re-installed in nacelles. Enlarged and re-designed tail surfaces improved stability and control.

In this form the Rs.II made a number of flights, and created considerable interest from German Naval Authorities and independent sources. The faith of the parent company was strengthened.

Nevertheless, It was realised that the Rs.II was a long way from an operational aircraft, though much had been learnt. It remained to transpose aerodynamic, hydrodynamic and structural exercises into something having endurance, reliability and load-carrying abilities. Damaged during testing by a damaged prop, the Rs.II airframe was used for static testing, while design of its successor progressed.

The Rs.III, of 1916 embodied many lessons learnt from its predecessors, and included many new ideas, some of which had been prompted by outside sources.

A boat type hull supported a broad-chord monoplane wing, from which a slim fuselage or boom supported a biplane tail. Four engines in tandem pairs were supported between hull and wing. Close spacing of the 240 H.P. Maybach engines avoided yawing tendencies in the case of engine failure. (A full description of the Rs.III occurs later in the text.)

Behaviour of the Rs.III both in the air and on the water was good, and service evaluation was commenced at Nordeney in August 1918, and was still under way at the Armistice. It is reliably reported that the Rs.III continued to be flown until both it and the Rs.IV were destroyed by the Allied Control Commission in July 1921.

Work progressed, meanwhile, on the further improved version, the Rs.IV. Layout was basically the same as the Rs.III, with one major difference. The

hull was made much narrower, and sponsons were added to improve stability on the water. This feature was to become almost a Dornier "trademark", and was much copied by other manufacturers later.

The main improvement in the Rs.IV, however, was not readily visible. Construction had been further refined. A mixture of steel and aluminium alloy utilising rolled, formed and composite built-up sections comprised the basic structure. The fuselage was of stressed-skin construction without internal bracing, and the hull was metal-clad.

Members of the Allied Commissions who inspected the Rs.III and Rs.IV after the war were most impressed by their size, and the sophistication of their construction. The Rs.IV in particular was a true milestone of aviation engineering.

Two digressions were made by the Dornier Company into the small aircraft field. As might be expected, the same radical originality of thought was applied to the problem.

The first aircraft, the C.I, was a 2-place land biplane conforming generally to German 'C' type aircraft specifications. It is believed that the primary purpose of the CI was to investigate stressed-skin construction methods used later in the Rs.IV. Contemporary records are rather vague as to whether the C.I flew; certainly its further development did not interest the Dornier group.

The same cannot be said of the D.I, which actually took part in the July and October 1918 fighter evaluation trials. The machine, a biplane with cantilever wings, no interplane struts, cantilever under carriage and with jettisonable fuel tank, was of exceptionally modern appearance. Construction again was all-metal. Unfortunately during tests on 3rd July the D.I suffered a structural failure of the top wing attachment struts and crashed with fatal consequences to the pilot, Haupt. Reinhard of JG 1.

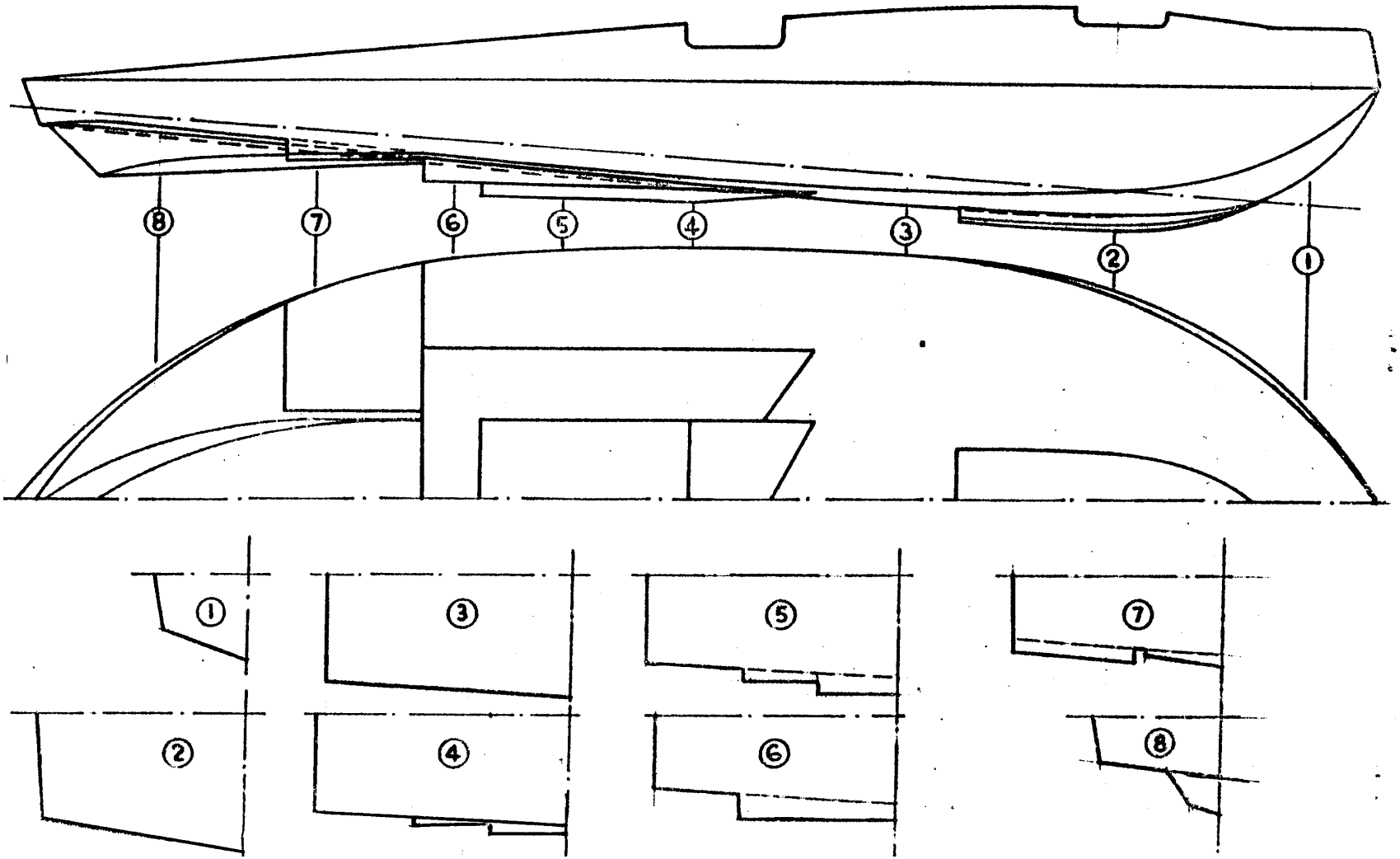
Also under construction at the end of the war was the Gs.I, a twin-engined (in tandem) flying boat. Dornier completed this as a civil aircraft. After having been successfully flown and proved economical and reliable, it too was destroyed at the order of the Allied Control Commission in 1920.

It can be confidently stated that the actions of the Allied Commissions were stupid and short-sighted in the extreme. Civil aviation must have been set back almost 10 years, for other advanced designs met a similar fate. These included those of Prof. Hugo Junkers, and Dipl. Ing. Rohrbach of the Zeppelin-Staaken Company, both of whom had extremely modern designs under way.

Dornier's first post-war design was the "Delfin" (Dolphin), a single-engined flying boat. The prototype was an appallingly ugly machine, but boasted

DORNIER (ZEPPELIN-LINDAU) Rs.III
SHEET 2

## HULL SECTIONS



enclosed accommodation for the passengers. Refinement of the design, by lengthening the hull and removal of the Pilot's cockpit to the cabin, eventually produced a compact flying boat of surprisingly modern lines. A land-plane version was known as the "Komet", and both types saw limited use.

In 1922 appeared the aircraft which was to set the seal on Dornier's success as a designer and constructor of flying boats. The "Wal" (whale) was to have great influence on civil and military flying boat design, and participated in much pioneer and exploratory work. A conventional design with full-length hull, sponsons, and two engines in tandem mounted on a monoplane wing, it was built in many versions. Total production exceeded 300.

Dornier had always maintained his faith in large aircraft. In 1926 design was commenced for a flying boat intended for transatlantic operation. The Do.X, was at the time of its completion in 1929, the world's largest aircraft. The all-metal structure spanned 157' 5" (48 m) and was 131' 4" (40.05 m) long. It was powered by 12 engines in tandem pairs, mounted above the broad-chord monoplane wing.

On 25.7.29 the Do.X lifted a record total of 169 persons, the largest number carried in heavier - or lighter-than air craft to that time.

The Atlantic proving flight of the Do.X was, alas, a disaster! Due to various accidents and mechanical failures, the trip from Friedrichshafen to New York via Lisbon, Natal and Miami took a full nine months.

The Do.X design remained plagued by engine over-heating and lack of power, and although 2 Do.X's were ordered by Italy, all three aircraft were ultimately scrapped. The conception and construction of the Do.X is, however, rightly regarded as a milestone in aviation history.

As we leave this short history of the Dornier designs, it is pleasing to record that the company is still in production. Its current designs retain an originality and simplicity characteristic of Claudius Dornier.

Detail Description of the Rs.III

| | | |
|---|---|---|
| Wing span | 37.00 m | (l21' 4") |
| Length overall | 22.750 m | ( 74' 8") |
| Height, (keel to tip of vertical stabiliser in flying attitude) | 8.200 m | ( 26' 11") |
| Length of Hull | 12.575 m | (41' 3") |
| Beam of Hull | 4.700 m | (15' 5") |
| Engines | 4 x 240 h.p. Maybach | |
| Airscrews (front) | 2 x "Behrend" 3 m dia. x 1.65 m Pitch | |

| | |
|---|---|
| Airscrews (rear) | 2 x "Bebrend" 3 m dia. x 1.70 m Pitch |
| All-up weight | 10,670 kg. |
| Airframe weight | 7,200 kg. |
| Fuel weight | 2,260 kg. |
| Power loading | 10.25 kg/h.p. |
| Wing loading | 46.9 kg/sq.m. |
| Ordered | 25th May, 1917 |
| Delivered | 19th Feb., 1918 |
| Accepted | 13th July 1918 |

Armament - None fitted, but provision for one machine gun in forward hull position, and two in cockpit on top of fuselage.

Construction

The construction methods favoured by Dornier were quite revolutionary. Little use was made of steel tubing as it was difficult to join except by welding (which process was at that time not highly developed). Alloy steel strip was formed into "V", "U", or "Clover Leaf" sections, all sections having flanges to facilitate riveting. Many of the basic configurations were used by Dornier thereafter, and were later extensively imitated.

It is probably not too sweeping a statement that the Dornier methods were the true foundation for all modern aircraft construction. Methods introduced by Fokker and Junkers proved incapable of development past a certain point, whence both companies reverted to the "Dornier" type of construction.

The Rs.III wing consisted of three main spars of steel, with Duralumin ribs. The spars, as with the Rs.II and Rs.IV, were of inverted triangular cross section, each consisting of 3 built-up tubes connected by a girder-truss of "U" channels riveted to flanges on the span-wise tubes. Most tubular sections were formed by riveting together 2 flanged "U" sections.

Ribs were wrapped with fabric, to which the outer fabric covering was sewn. The wing structure was externally braced by stout steel cables.

The broad, boat-shaped hull was built entirely of metal, mostly duralumin and was of conventional bulkhead and longeron frame, covered with duralumin sheet. A peculiarity of the hull was the multiplicity of steps on the planing surface, no less than seven being located at intervals over much of the wetted area.

Fuselage was of steel tubular longerons with dural frames, cross-braced with cables. Covering was dural forward of the rear spar, and fabric abaft it.

The tail section consisted of a wire-braced bi-plane stabiliser, and split fin and rudder, with metal framework and fabric covering.

A slightly primitive touch added to an otherwise sophisticated design, was the exposed ladder leading from hull to fuselage. Still, German "R"-plane crews were pretty tough!

One point hitherto not mentioned was the "Park bench" type aerodynamic balancing surfaces attached to the ailerons; this Dornier practice continued at least up to the Do.X, and possibly beyond.

Bibliography

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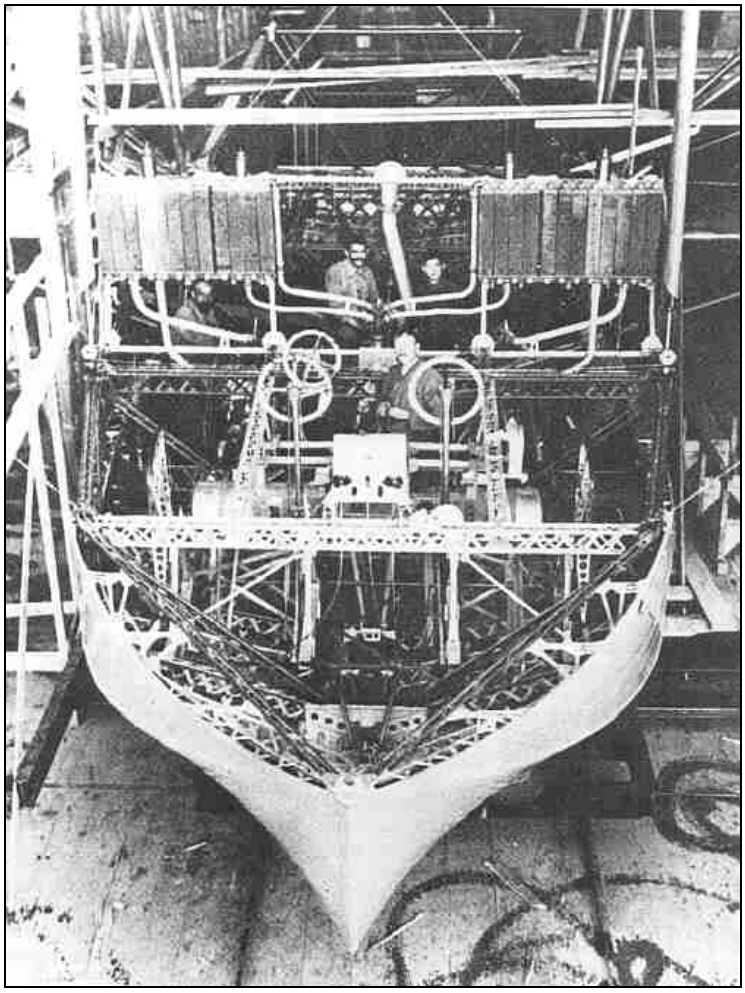
Acknowledgements

Thanks to Society members D. Pardee and C.A. Owers for material forwarded in answer to queries.

Note

Copies of a 1/72 scale drawing suitable for model-building will be available for a limited period through the Secretary.


The Dornier Do.X in New York harbour.



Left: The Dornier Rs.II fuselage under construction. Note the extensive use of dural framing clearly visible.

Below: The Dornier Rs.III