Some French steel structures executed during 1932 - 1936

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Some French Steel Structures executed during 1932—1936.

Einige in den Jahren 1932 bis 1936 in Frankreich ausgeführte Stahlbauten.

Quelques constructions métalliques exécutées en France de 1932 à 1936.

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I. General considerations.

The years from 1932 to 1936 were a period of stabilisation after the crisis which had affected every branch of industry and the metal industry in particular. Following on the exceptional years 1929 and 1930 the production figures still declined, but they did so less violently. From 1932 onward they became stable or showed some slight trend towards recovery: an index, if a slight one, of the reviving activity.

One of the most striking of the characteristics discernible in the work of the French builders of metal structures is the quest for improved or new methods designed to secure lower costs through better use of the possibilities inherent in steel.

Among these new methods a special place must be given to electric arc welding which has steadily progressed to a level of perfection that is a guarantee of safety, and in doing so has opened up new horizons to the art of construction in metal. At the same time real advances have been made in resistance welding, so that heavy structures are now included in its scope.

The demand for lightness of structure without detriment to solidity has led to the wider and wider use of high-tensile steels. In certain cases even rustless steels, despite their higher cost, have been found advantageous.

The same search after lightness has given rise to some new and original solutions, particularly in reference to floors of buildings, bridges, and aeroplane sheds.

It will not fall within the scope of this report to describe all the striking ideas that have been brought out during the past few years — most of them still in an uninterrupted course of development. We shall confine ourselves to a brief review of the most essential of the achievements.

II. Steel frames of buildings.

The number of steel framed buildings built between the years 1932 and 1936 is so great that only a selection can be dealt with, and five of the most important are mentioned here as representing different fields wherein the use of steel has been found particularly well adapted to the end in view.

1) The Shell Company's building in Paris (Figs. 1 and 2).

This structure was erected by the firm of Borderel and Robert together with Baudet, Donon and Roussel. It covers an area of 8000 m² and is notable not only for its architecture but also for the details of its planning.

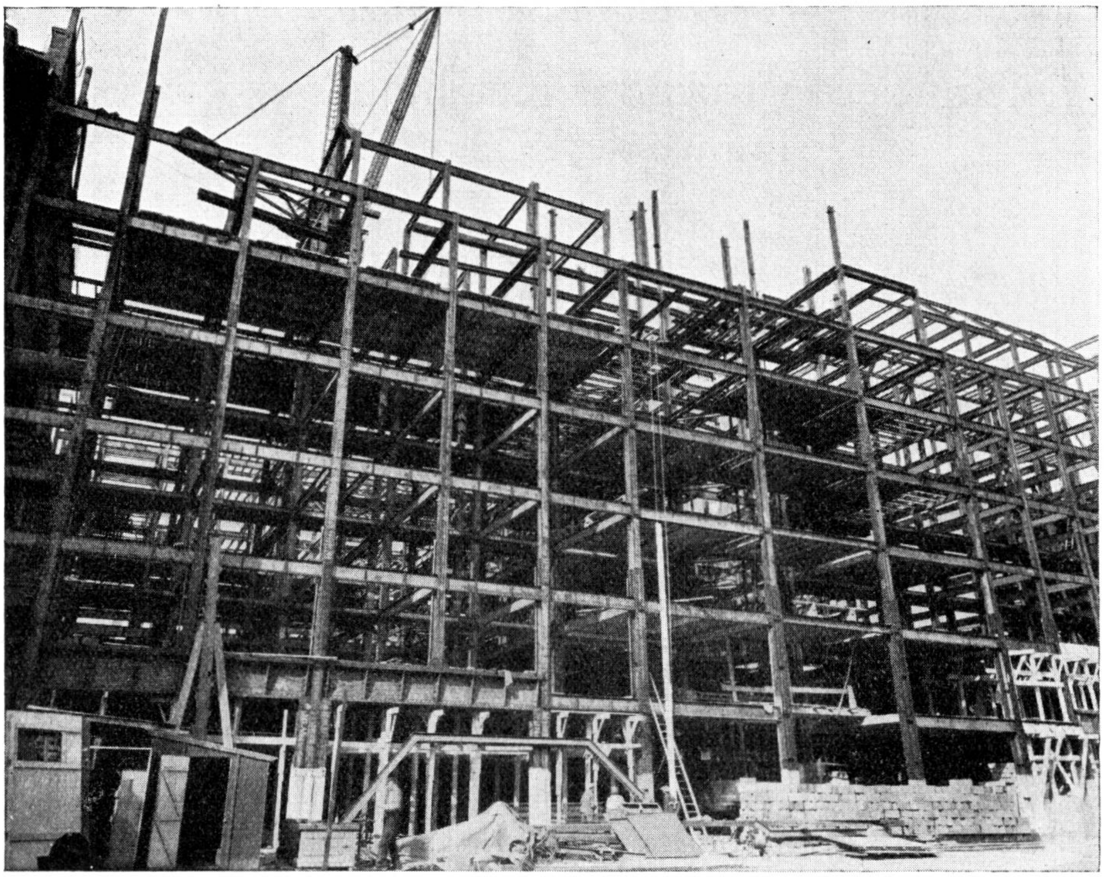


Fig. 1.
"Shell" Building. Steel frame work.

The building includes foundations and three basement storeys in reinforced concrete and above these some 5000 tonnes of steel framework enclosed in concrete to reduce the risk from fire. Everything has been designed and calculated with a view to a maximum attainment of those features which offer the greatest advantage. For instance, a point has been made of using members with very broad flanges up to sections such as 500 mm $\times$ 300 mm and no compound members have been used, the whole of the framework being encased in reinforced concrete to protect it from fire.

The facings of the building are attached to the framework by the use of new methods of construction, and their architectural composition is both sober and distinctive. It is characterised by high pilasters, surmounted by pinnacles, which emphasize the vertical lines. The great length of the facades is broken by projections of greater height, bearing the name "SHELL' in large letters.

2) The medical school at Lille (Fig. 3).

The new medical school was included in the first stage of construction for the *"Cité Hospitalière"* at Lille. The premises consist of a symmetrical group of buildings extending over a frontage of about 140 m and having a developed length of 230 m. The central portion and the wings have six storeys, each with an area of 3100 m². The west and east lecture theatres, with their adjoining rooms, each cover an area of 360 sq. m. and correspond in height to two storeys of the adjoining portions.

The framework, including floorbeams, main and secondary girders and stancheons, is of steel, and in general the stancheons are supported on the first floor which is of reinforced concrete. 2000 tonnes of steel were used for the

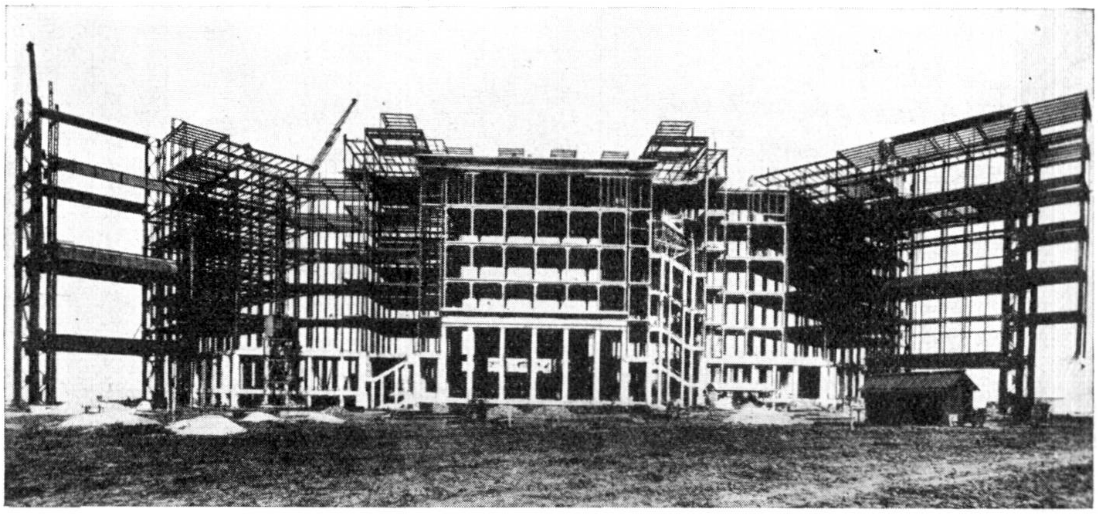


Fig. 2.

Medical Faculty Building, Lille. Steel frame work.

framing as a whole. At the seventh storey, over the whole length of 90 m between the east and west theatres, there is a steel roof construction over the accomodation for animals.

Further applications of steel framing occur under the rising seats of the Great Theatre seating 600 and in the roofs of the Dissecting Room and Operating Demonstration Theatre.

This imposing steel frame was raised from the ground in the course of a few weeks with the aid of electrically operated machinery and derricks. Notably in the construction of the facade, visitors never failed to be attracted by the combination of gracefulness and strength present in the powerful electric travelling and turning crane, with three motors, the jib of which could reach a height of 42 m and could reach horizontally a distance of 20 m.

Reference will now be made, from a technical standpoint, to an interesting detail in this superstructure: at the request of the commission of experts under the chairmanship of Monsieur Dautrey, Director of State Railways, the firm of Paudon et Cie. to whom the steelwork was entrusted made use of the principle of continuous and superimposed frames. This implies an arrangement of specially designed connections to ensure the vertical and horizontal bond between the columns and the girder work carrying the floors.

Furthermore, the columns were formed of high-strength steel so as to lighten the metal framework while at the same time adding to its strength.

3) The Rex Cinema in Paris (Fig. 3).

The Rex Cinema covers a trapezoidal-shaped site of about 1900 m² and was built by the firm of Baudon jointly with that of Venot-Peslin.

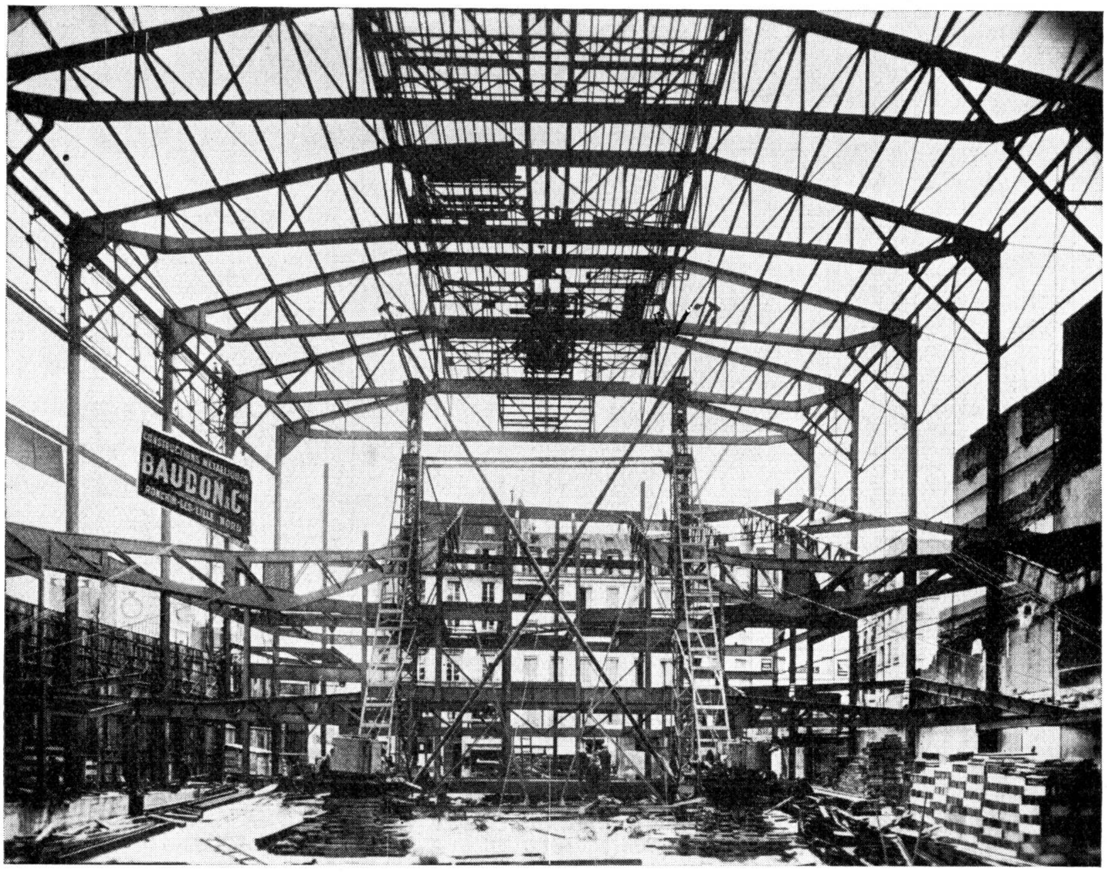


Fig. 3.
"Rex Cinema". Steel frame work.

The auditorium has an average width of 34 m and a depth of 31.5 m along its axis. The substructure of the building, up to ground floor level, is in reinforced concrete, and the remainder is supported on a steel framework.

The principal members of this framework were erected into place by means of two large masts 36 m high, each separately capable of lifting 15 tonnes. As soon as the general framework was in position work was begun on filling in the walls and the screens intended to isolate adjacent buildings in case of fire; meanwhile the work of erecting the steel framing of the balconies procceded inside.

The wall-fillings were erected with great speed in the form of hollow concrete blocks. These were pre-cast on the site and laid in cement mortar several courses at a time with reinforcement in each joint; subsequently they were bonded and reinforced by round steel bars placed vertically through the hollows into which concrete was poured. In this way a monolith was obtained when the concrete had set.

Roof trusses.

The main roof trusses, seven in number, have been built as lattice structures, and are so designed as to produce no laterial thrust on the supporting columns which are relatively light in section. A further consideration was the necessity to ensure that the upper boom should remain absolutely horizontal under load as it forms the support for office floors; this requirement was met by fabricating the work with a suitable camber.

The middle part of the upper boom is horizontal over a length of some 12 m to carry the floors of offices which are situated over the whole length of the auditorium. The lower boom is horizontal over the greater part of the span but rises on each side towards the supports, where it is reinforced with large gusset plates which also serve to make the connection with the supporting columns. At the point of intersection with each of the oblique members there is placed a strut to afford lateral bracing and to pick up the suspension bars carrying the edge of the cupola over the auditorium. This strut is relieved in its middle portion by two diagonal members, and at the last truss, which is the smallest, it is replaced by a horizontal bar which is in line with the horizontal portion of the lower boom and connects with the stancheons so as to afford lateral bracing also.

It may be noted that in no case does the axis of the truss coincide with the centre of the span, the difference in length of the two half-units being 1.40 m in the largest truss.

The connection between the bracing, the diagonals and the stancheon by means of bolts in oval-slotted holes was not finally made until the truss was under load, so that the deflection should already be present and there might be no risk of causing any thrust at the points of intersection.

As the building is trapezoidal in plan all seven trusses have different spans, varying from 33.90 m to 38.60 m, and their heights likewise range from 3.50 m to 6 m. The largest truss, weighing over 24 tonnes and carrying a total load of about 200 tonnes, is the closest to the screen. Consequently the depth available between the ceiling of the auditorium and the floor of the offices over the theatre varies from one end of the building to the other, being at its smallest over the upper seats of the amphitheatre. This depth is turned to account for housing part of the equipment, especially the ventilation ducts.

Galleries.

The general framework carries the steel frames of the two galleries which are not supported on any intermediate column. The balconies are borne by cantilevers each erected behind one of the columns of the main framing, and their projection is reduced by an intermediate girder running parallel to the front of the screen which picks them up near the middle of their length and in turn rests on two skew girders supported on columns forming part of the framework. So far as possible the span between supports has been made to balance the cantilevered portion, when under average live load.

The two skew girders carrying the trimmer of each gallery (the span of which is thereby reduced to two-thirds the width of the auditorium) are supported externally on a steel column in the outside wall and internally on a column in the curved wall dividing the auditorium from the foyers. Each of the skew girders consists of two twin lattice girders forming a box of pentagonal (almost triangular) shape, the greatest height of which is in the plane of the intermediate girder. The latter carries the cantilever beams of the galleries and is likewise a lattice box girder but of constant height.

The eight cantilever girders which carry the floors of the galleries are of lattice construction and nearly triangular in shape. At the back they frame into one of the columns of the curved wall of the foyers, and under each gallery six of them are picked up on an intermediate girder while the other two bear directly on the skew girders at their intersections with the latter. Being thus supported near the middle of their length these brackets form true cantilevers, the upper portion between supports serving to balance the projecting portion.

The gallery brackets have been designed and tested under a moving live load of 500 kg/m^2.

4) The new Citroën works at Paris (Fig. 4).

Finally, mention may be made of the group of steel frameworks built by the Compagnie Saint-Quentinoise de Construction for the Citroën Company. This workshop structure, erected on the Quai de Javel in Paris, comprises a central

Fig. 4.
Citroën Motor Works.

hall of 24 m span by 228 m long, with a height of 12 m to the underside of the roof trusses. The stancheons carry a gantry for a 10-tonnes travelling crane.

Five bays of 16 m span connect on either side of the central bay, and these include steel floors for live load of 500 kg/m^2.

The steelwork as a whole amounts to 8000 tonnes, and it is of interest to observe that delivery and erection was effected at the rate of 1000 tonnes a month.

III. Bridges.

From among the many bridges erected by French constructors between 1932 and 1936 we shall select three of different types which are noteworthy for their size and the neatness of their design.

5) Rolling-lift bridge at Dunkirk (Fig. 5).

This is a combined bridge for both rail and road traffic and was built by the firm of Dayde over the new dock in the Port of Dunkirk.

It includes a roadway 5 m wide with a railway of standard gauge laid on the centre line, and two footpaths 1.25 m wide. The bridge is of the Scherzer rolling lift type, and its maximum opening corresponds to a rotary movement

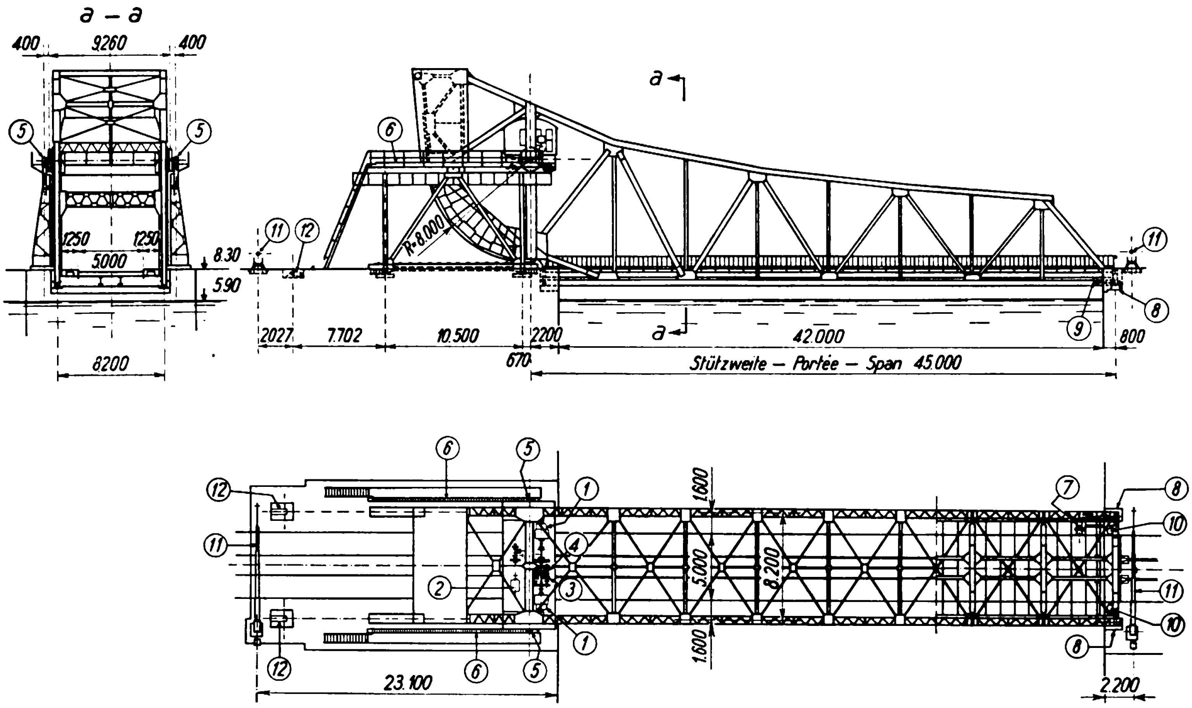


Fig. 5.

Drawbridge at Dunkirk.

1) Electric motor 162 HP.
2) Petrol motor. Renault 46 HP.
3) Mégy brakes.
4) Electro-magnetic brakes.
5) Cog-wheel drive.
6) Cog-rail.
7) Motor for locking gear.
8) Bearings.
9) Locking gear.
10) Shock absorber.
11) Turn pike.
12) Anchorage for bridge when open.

of 85^0 combined with a movement of translation of 11.84 m, leaving a clear distance of 42 m between the walls of the dock.

The lifting span includes the following parts:

— A pair of stringers carrying the roadway, railway and footpaths, these being lattice girders of varying depth and of 45 m span spaced at 8.20 m centre to centre, connected by cross girders at 5.5 m centres carrying the deck.

— A rolling portion formed of two girders in the shape of circular arcs, inter-connected above the roadway by a steel framework.

— A counterweight supported on this framework.

The side of the abutment under the rolling portion of the bridge is furnished with two rolling tracks 12.8 m in length, and when the bridge is opened or closed the circular girders roll in these. The abutment also carries two mountings for racks arranged to engage with toothed pinions forming part of the operating gear.

Operating gear.

All the operating mechanism is mounted on a trolley with a horizontal platform guided to move horizontally when the bridge is lifted or lowered, through a patented device known as the Daydé system. The motion is given by a direct current electric motor of 162 H.P. fed from a Léonard transformer set in the control cabin, and the latter is supplied by 3-phase alternating current at 50 periods with 380 volts between phases. A standby motor placed opposite the first one can be brought into use in case of need.

The bridge is held fast in any position by the agency of two electromagnetic brakes when the current is cut off. An automatic brake is provided which opposes any tendency of the bridge to move in the wind. A petrol engine for emergency use is installed below the machinery platform and there is also hand operating gear worked by hanging chains.

The bridge can be opened or closed in 100 seconds against a contrary wind pressure of 50 kg/m^2.

Locking gear.

A lock bolt, operated electrically from the control cabin and interlocked with the lifting gear, is provided at the end of the cantilever.

Anchorage in open position.

The bridge, when fully opened, can be anchored by means of connecting rods securing the counterweight box to a metal pedestal embedded in a foundation block. This anchorage is designed to withstand a wind pressure of 150 kg/m^2.

Shock absorbers.

Two shock absorbers are arranged at the end of the lifting portion of the bridge to take up any impact that may occur on completion of closure.

Barriers.

At the entrances to the bridge over each abutment there are two lifting barriers worked electrically from the control cabin. These are fitted with both audible and visual signals.

The work is the fourteenth lifting bridge of the same type built by the firm of Daydé.

6) The Moissac bridge (Fig. 6).

The old Moissac bridge carrying the Bordeaux-Sète railway across the Tarn had failed through settlement of the piles resulting from a severe flood in that river. The new bridge, built by the firm of Daydé, has three continuous spans of varying height, namely —

120 m in the central span,

95.7 m in each side span, these being supported on two piers in the river and on two abutments.

The main girders are of lattice construction varying in height, and are at 9.5 m between centres. The lower booms are horizontal and the upper booms

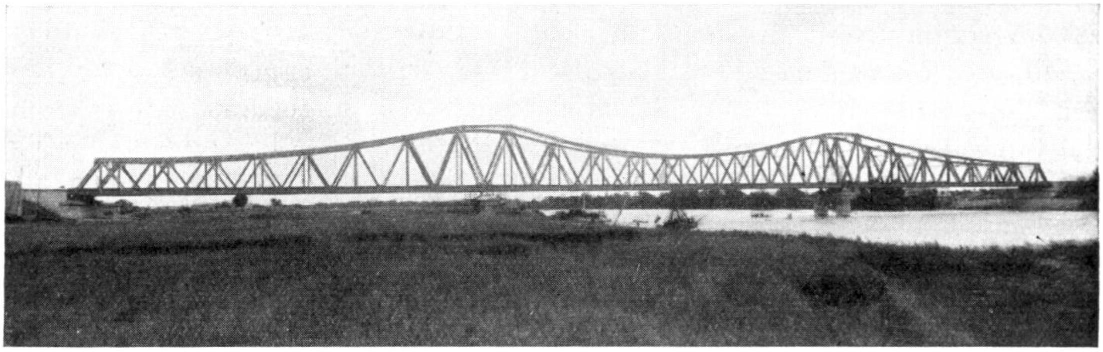


Fig. 6.
Moissac Bridge.

form polygons with a horizontal portion over each of the piers. This elevation is the result of omitting vertical members over the piers and it confers on the bridge an effect of great lightness.

The height of the girders is 18.5 m over the piers, diminishing gradually to 10.5 m at the middle of the central span and 8.5 m at the ends over the abutments.

The upper and lower booms of the main girders are connected by a simple lattice in the form of a V with verticals joining into the upper intersections of the lattice.

The cross girders, spaced at 5.4 m to 7 m centres, are connected by four lines of rail bearers of I-section, placed under the rails.

The bracing system consists of cross members in the planes of the compression diagonals, together with a horizontal triangulation, in the shape of a St. Andrew's cross, lying in the plane of the seatings of the lower booms. These cross members, the diagonals and the corresponding cross girders constitute rigid frames which serve to carry wind stresses from the upper part of the bridge to the horizontal lower bracing.

The bearings are of the rocker type fixed on one pier and mounted on rollers on the other pier and on each abutment.

Erection and assembly of the steel superstructure.

Erection on falsework was ruled out by the fact that the nature of the ground on the side of the job made it impossible to drive piles to a sufficient set, and moreover the designers favoured the method of erection by launching, even having regard to the great size of the bridge.

Each half of the superstructure was erected on a suitable platform over the bank and was drawn into its final position by an electric winch, moving on rollers over the erection platform, the abutments and the piers. To relieve the stresses in members of the main girders the latter had to be reinforced temporarily by an additional lattice system. In addition to this the stresses due to the maximum cantilever effect were reduced by the employment of a steel forerunner 40 m long.

As soon as the two halves of the bridge were fully launched they were aligned with one another, an operation which required to be done in such a way that the internal forces arising would correspond to those calculated on the hypothesis of continuity of the spans. To ensure this, the ends over the abutments were lowered by an amount calculated to bring the middle portions of the lower booms into a horizontal position, and the parts thus aligned were then riveted. Finally the decking was lowered onto its supports and the lower booms brought to their proper relative level.

The adoption of this procedure gives an absolute assurance that the stresses in all the bars are the same as if the bridge had been erected on falsework.

In the Moissac bridge the total weight of steelwork is 2714 tonnes. The simplicity of line and pleasing aspect which characterise this bridge are convincing evidence of the aesthetic feeling of its designers.

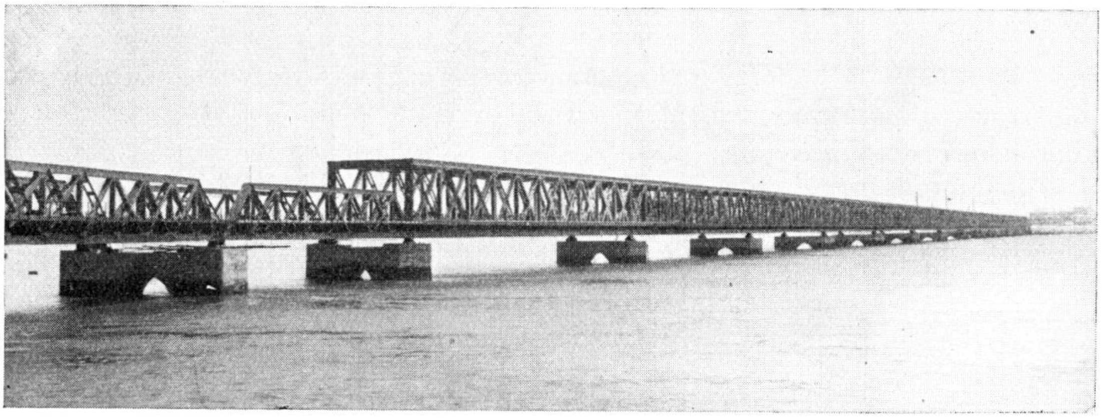


Fig. 7.

Approach Bridge to Mole at La Rochelle-Pallice.

7) La Rochelle-Pallice viaduct (Fig. 7).

The landing jetty now under construction within the port of La Rochelle-Pallice will be connected to the shore by a steel viaduct supported on concrete piers. This viaduct was the first part of the work to be undertaken and is now finished.

Starting from the land end, it includes: 1) two series of six continuous spans each, on a straight line of total length 840 m, and 2) six separate spans, arranged in plan with their longitudinal axes forming a polygon enclosing a circular arc of 192.5 m radius and 280 m development. What follows refers to the continuous spans in a straight line, which have been built by the firm of Daydé.

Each span is of 70 m between centres of supports, and they carry a double carriageway with a standard-gauge railway alongside. The clear width between the main girders is 10 m, and there are two footpaths 1.5 m in width corbelled out from the sides.

The main girders have parallel booms and are 9.5 m high from back to back of angles. The lattice work is in the form of St. Andrew's crosses with the addition of verticals connecting the lower booms to the intersections of the diagonals. The booms are of double construction.

The decking below the roadway is formed of cross girders spaced at 7 m centres and connecteted by seven rows of longitudinals, two of which come immediately below the rails of the railway.

The girders are connected at the top by lattice struts and by horizontal wind bracing. A second system of horizontal wind bracing is arranged in the plane of the bearing plates of the lower booms.

The decking is covered with reinforced concrete. The sidewalks, likewise, each consist of a reinforced concrete slab carried on two lines of longitudinals which in turn rest on steel cantilevers connecting to the vertical members.

The two sets of continuous spans were erected on dry ground at the approaches of the viaduct and were brought to their final position by successive launching operations. The total weight of the 12 straight spans is 5600 tonnes, and at the end of the launching process of each group of six spans the total weight being moved reached nearly 3000 tonnes.

IV. Welded Bridges.

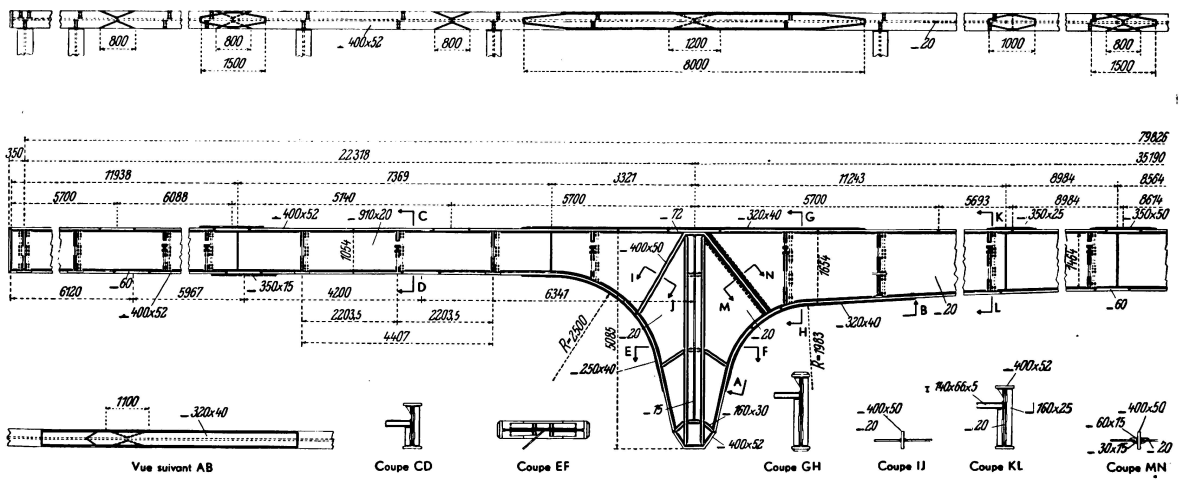
Welded construction has undergone considerable development during the past four years. Structural engineers at first held back, but little by little they have come to appreciate the possibilities and advantages of welding as applied to the field of steel frames and bridges.

From among a great number of steelwork jobs carried out by welding, we have selected the three bridges described below as best exemplifying the degree of strugth and flexibility which can be afforded by this new method of connection.

8) *The "Porte de la Chapelle" Bridge in Paris* (Figs. 8—10).

The works undertaken by the City of Paris with a view to improving traffic conditions at the exit from La Chapelle city gate involved the replacement of existing railway structures by a skew railway bridge at an angle of about 41°.

The new structure has been carried out by the Schwartz-Hautmont bridge-works in accordance with a general plan drawn up by the Nord Railway company. It comprises two steel floors, practically identical, placed side by side, each borne by two main girders and supported in the middle by columns, the ends of which rest freely on the abutments through the medium of expansion bearings (giving a vertical reaction). The intermediate columns rest on the ground by means of rollers.



Coupe = Section   Vue suivant = seen from below.

Fig. 8.

The "Porte de la Chapelle"-Bridge in Paris.

Details.

The bridge has a total length of 79.8 m in three spans, the central one being 35,2 m and the two side spans 22.3 m each.

In each floor the two main girders spaced at 4.05 m centres are connected by cross girders at right angles, and these in turn carry two lines of longitudinals to which the sleepers are fixed by hook bolts. At the ends of the floors the longitudinals are cut short and bear on the abutment through cast steel shoes (Fig. 9).

As the railway is on a curve, the rail bearers under each of the decks are arranged along the sides of a polygon without any interval at the connections between the railbearers and the cross-girders. Footpaths are carried on the

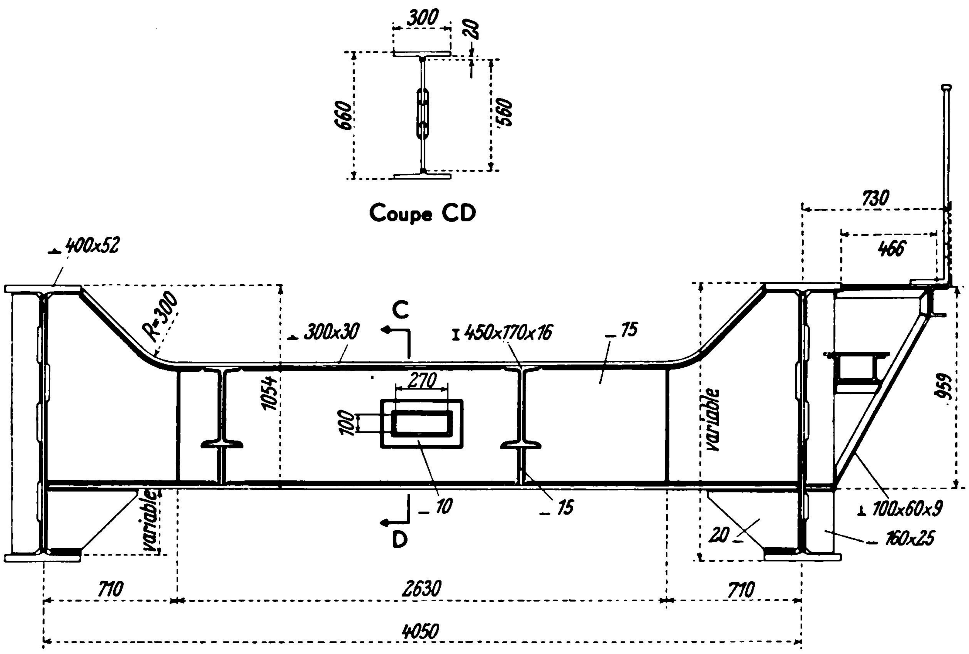


Fig. 9.

Porte de la Chapelle Bridge, Paris.

Section trough decking,

outside main girders by means of cantilevers, the ends of which are connected by joists along the edge. Since it is necessary that the decking should be watertight, this is secured by the use of continuous plates 8 mm thick, which cover the girders, cross-girders, rail-bearers and side joists. A system of piping and guttering is provided to carry the rain water from each span of the bridge into the gutters at the sides of the road underneath.

The intermediate supports have a plate web 20 mm thick, to which the flanges are welded. Each of the latter is a specially rolled section with a central protrusion allowing the use of butt-welded joints. The flanges are 400 mm wide and 52 mm thick, and the lower flange is in each case continuously connected to the wings of the struts. The joints in the web are butt-welded, but some of the joints in the flanges are welded with an X-seam in accordance with the regulations issued by the relevant Ministry in June 1935.

The main girders of the central span are 1.32 m high over the web at the centre, increasing to 1.51 m at the beginning of the strutted portion. The side girders have a uniform height of web of 0.91 m and their webs are provided

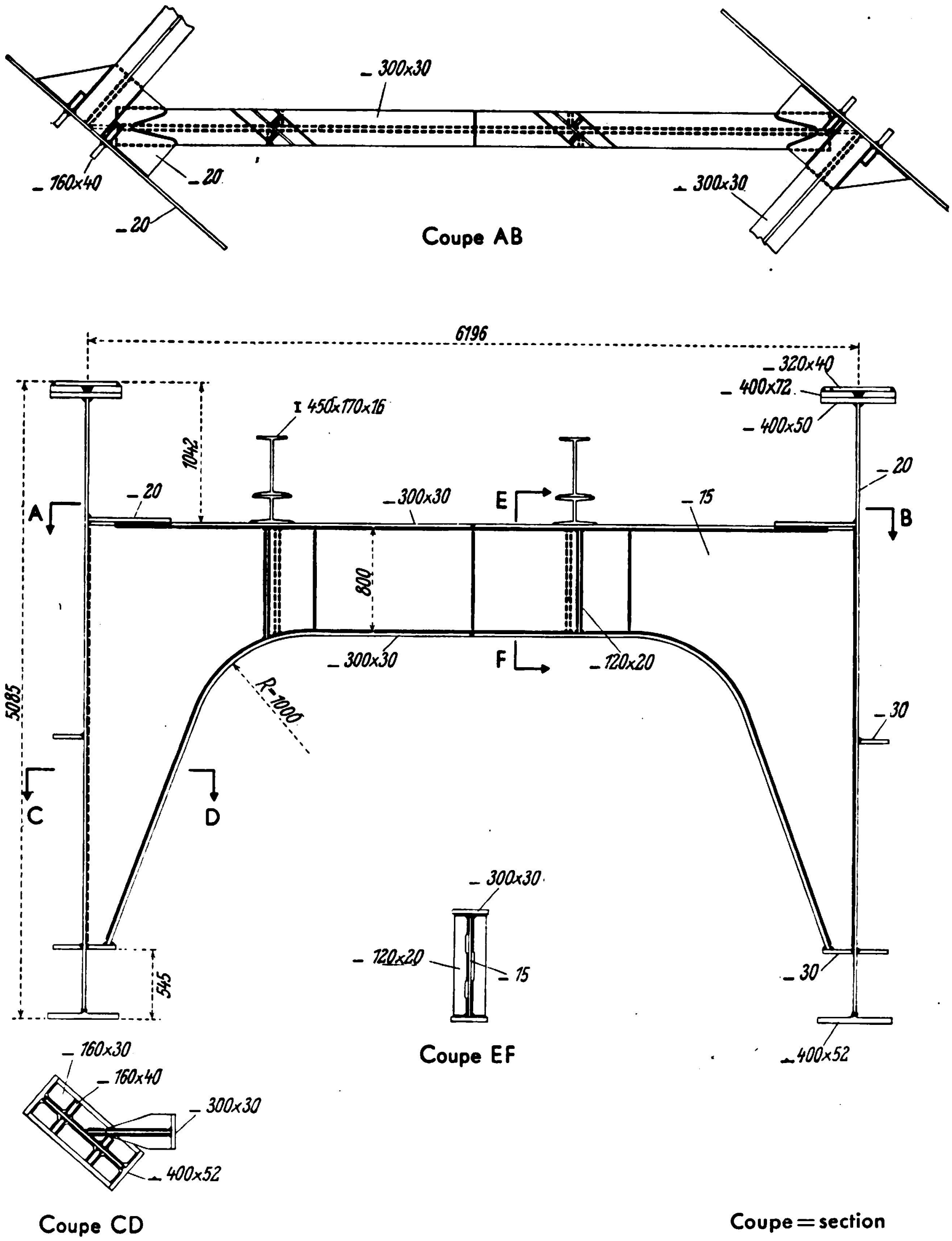


Fig. 10.

Porte de la Chapelle Bridge, Paris.
Wind bracing.

with stiffeners at approximately 2.20 m centres. The latter are welded to the web and to the two flanges on either side, the inside and outside stiffeners being slightly staggered in relation to one another.

The intermediate supports, which are necessarily made continuous with the girders, are formed with a web 20 mm thick, to which the following members are welded: —

1) Connected obliquely at the top, a plate 50 mm thick, to which the web of the horizontal girder is fixed.

2) Connected by a butt joint, the bulbed section which forms the continuation of the lower flange of the horizontal girder.

Stiffeners are suitably arranged to give the necessary rigidity to the crutches, and the ground end is supported on a hinged joint. Each pair of intermediate supports is connected by crossportals to maintain the verticality of the main girders and supply the wind bracing of the bridge. These portals themselves consist of crutch frames having a web plate 15 mm thick cut to a suitable shape and having welded to it at right angles two flanges 0.30 m thick (Fig. 10).

The transverse wind bracing of the bridge is completed by struts formed of webs 15 mm thick butt-welded to bulbed flanges 30 mm thick. The webs of these struts are welded to the inside of the webs of the main girders and form stiffeners for the latter. The wind bracing system is further amplified by an intermediate strut consisting of a No. 14 rolled joist.

The rail bearers placed immediately underneath the rails are formed of standard rolled steel joists No. 45, and are welded to the cross-girders.

Welding was used both in the workshop and on the job, but a few of the secondary members were riveted.

9) Bridge at Soissons (Figs. 11—14).

Leading out of Soissons (Aisne), the Nord Railway Company have constructed a skew railway bridge with two continuous spans and a side footpath carried on cantilevers. The work was entrusted to the firm of Paindavoine

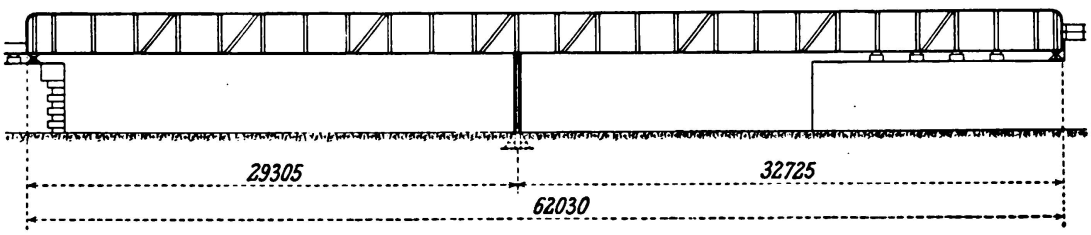


Fig. 11.

Soissons Bridge. General arrangement.

Frères in accordance with a general plan drawn up by the Nord Railway Company.

The bridge is of the straight girder type with solid web, and the main girders are spaced at 4.90 m centres, in each of the two continuous spans of 62.95 m and 62.03 m respectively. Each of the main girders is 2.25 m high and is supported close to its middle point by a stancheon 4.49 m high hinged at top and bottom, bearing at one end on a welded steel seating and at the other end under the girder itself. At either end of the bridge the girders rest on abutments through the medium of hinged expansion bearings.

The web plates of the main girders are 10 and 18 mm thick, and the two flanges are of specially rolled sections having a protrusion, which is welded to the web by butt welds. The flange plates have a uniform width of 400 mm

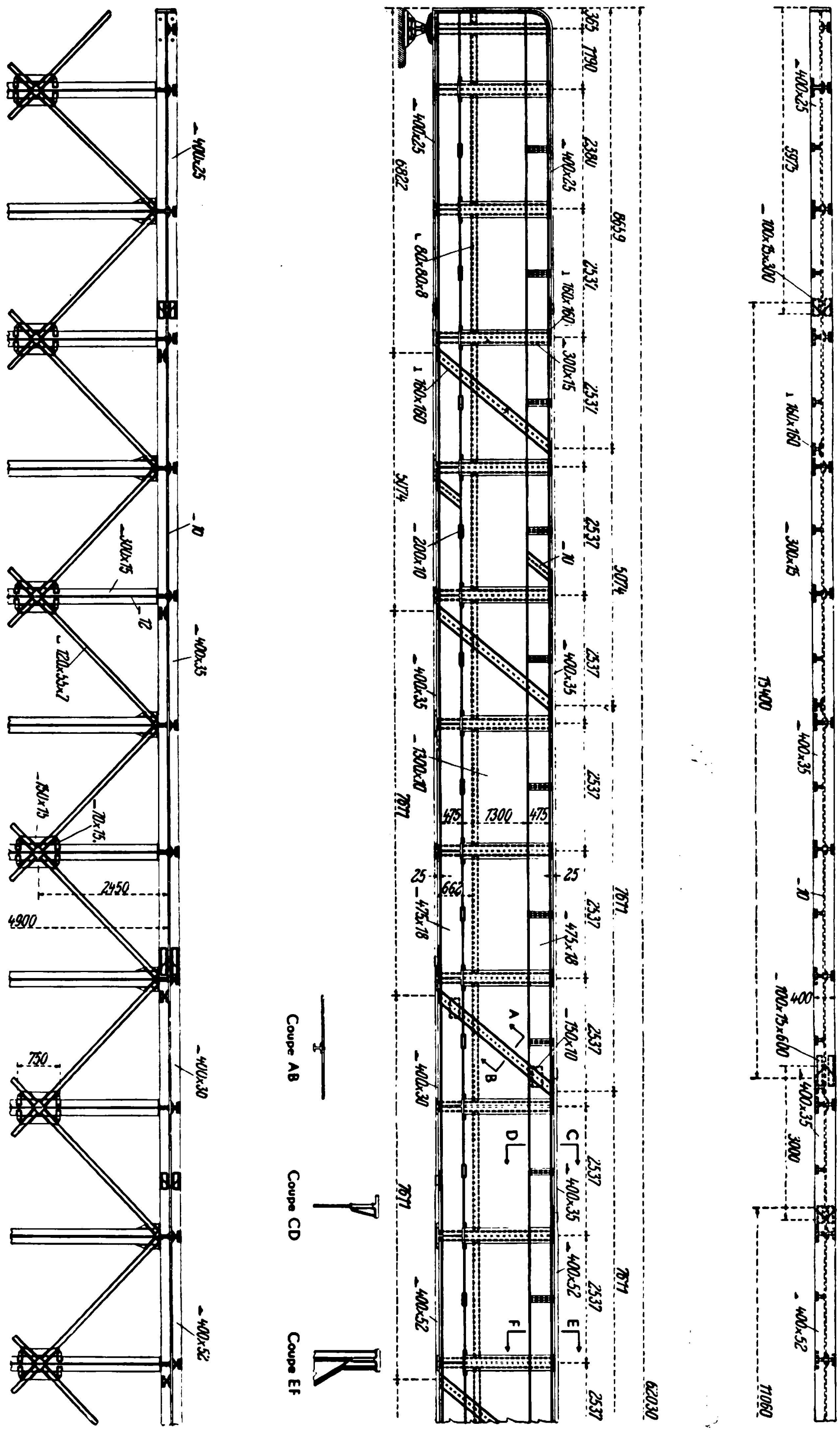


Fig. 12.
Bridge at Soissons.
Details.

and their thickness varies according to the value of the bending moment, being 25 mm, 35 mm, or 52 mm, as requisite. They have butt welded "V" joints under cover plates.

The web is made up of three successive widths of plate vertically superimposed, butt welded along the whole length, the heights of these being respectively 0.475 m, 1.300 m, and 0.475 m. The upper and lower plates are 18 mm thick, and the middle plate 10 mm. The successive lengths of plates are butted against one another on lines inclined to the vertical, the joints in the top and bottom plates being staggered with reference to the joints in the middle plate.

Stiffeners of "T" section are arranged at regular intervals of 2.537 m, welded to the web and to the two outside flanges of the bridge. The longitudinal joints of the web are further reinforced by inclined stiffeners, and on the inside there is cross bracing in the form of an inverted portal which serves to stiffen the main girders. These struts are formed of a web 12 mm thick and 0.45 m high, welded to the two flanges, these consisting of bossed sections 0.30 m wide and 15 mm thick.

The rail bearers immediately underneath the rails are formed of rolled I sections with very wide flanges 30 cm × 30 cm — these being connected to the cross girders by welding (Fig. 13).

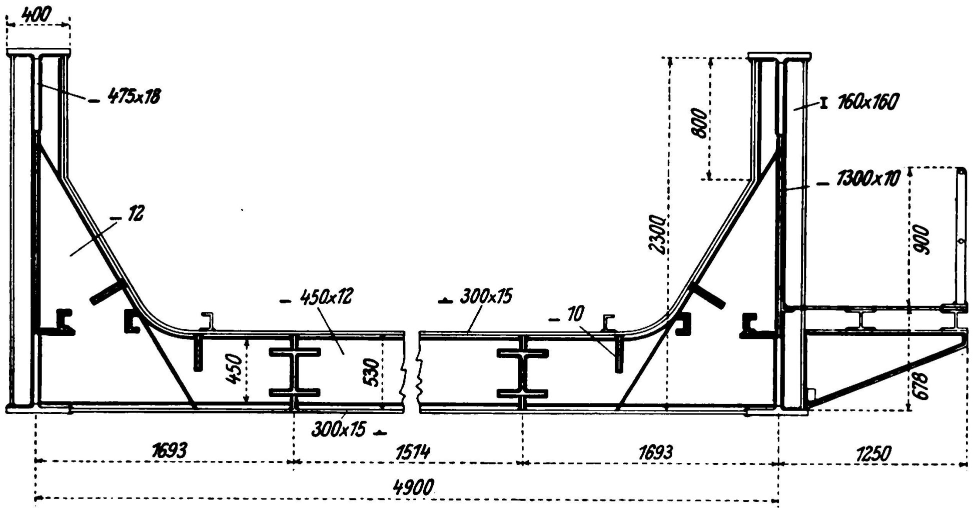
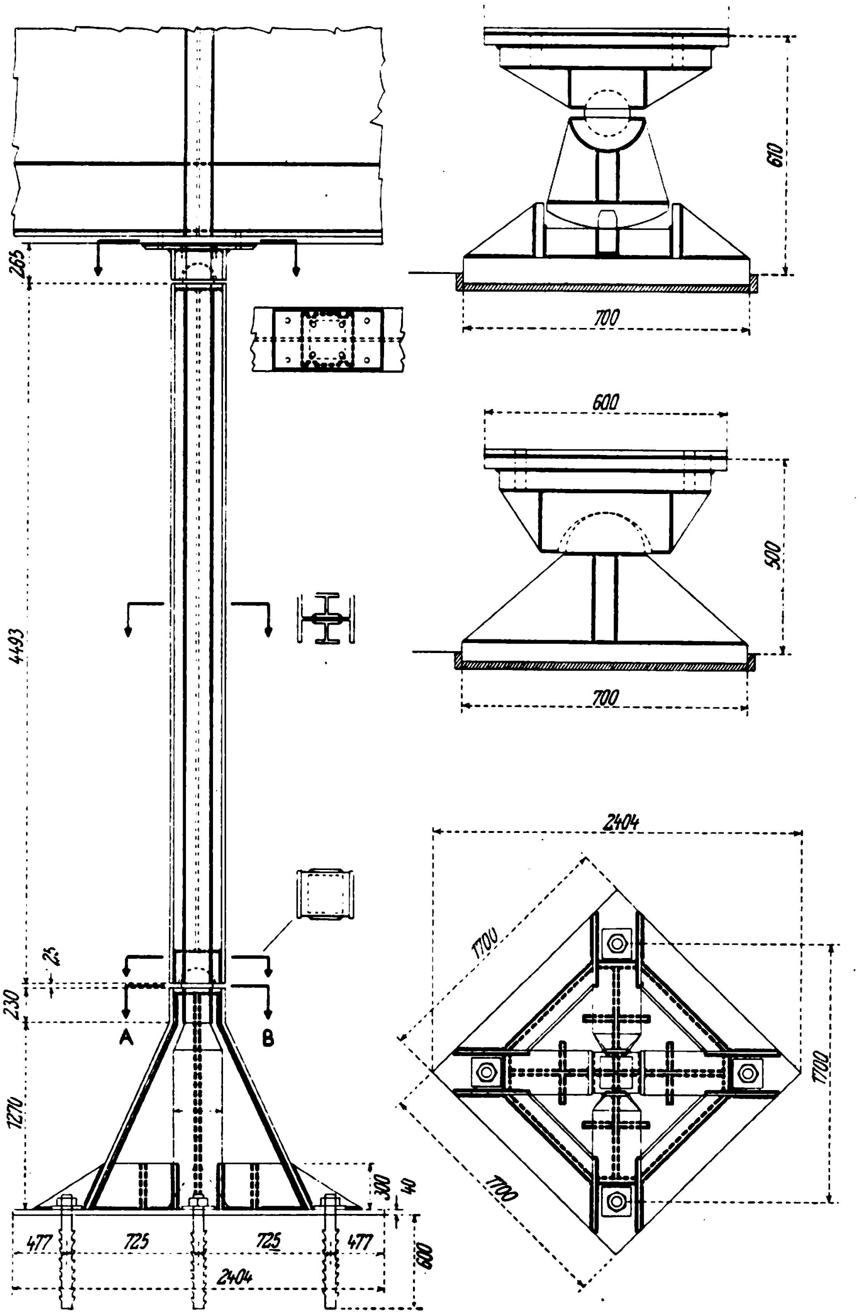


Fig. 13.
Soissons Bridge. Section through decking.

The columns under the middle of the bridge consist of a broad flange I-section 36 cm × 30 cm taken straight from the rolls with two broad flange I sections of 15 cm × 15 cm welded onto either side of its web. The top and bottom ends of the columns are provided with welded connections to carry roller joints (Fig. 14). The base of the column is a welded framework in the shape of a pyramid, formed of plates with suitable cross-pieces and stiffeners. At either end of the bridge each of the main girders rests on a hinged joint. The bearing is fixed at one end and moveable at the other, the moving end being a roller in a suitable track. In each case the work of fabrication was simplified by welding.



Section AB

Vue en plan AB = seen from above.

Fig. 14.

Soissons Bridge, Intermediate hinged columne.

10) The Neuilly Bridge.

The construction of a welded bridge over the two branches of the Seine at Neuilly near Paris was entrusted by the Administration des Ponts et Chaussées to the firms of Baudet, Donon and Roussel.

The Bridge has two arches, one over each branch of the river. One arch is of 67 m span between centres of hinges, and the other of 82 m. The two arches are practically identical in construction and dimensions, and only the one of 82 m span will be described here.

The decking of the bridge is carried on twelve 2-hinged arch ribs of 6.08 m

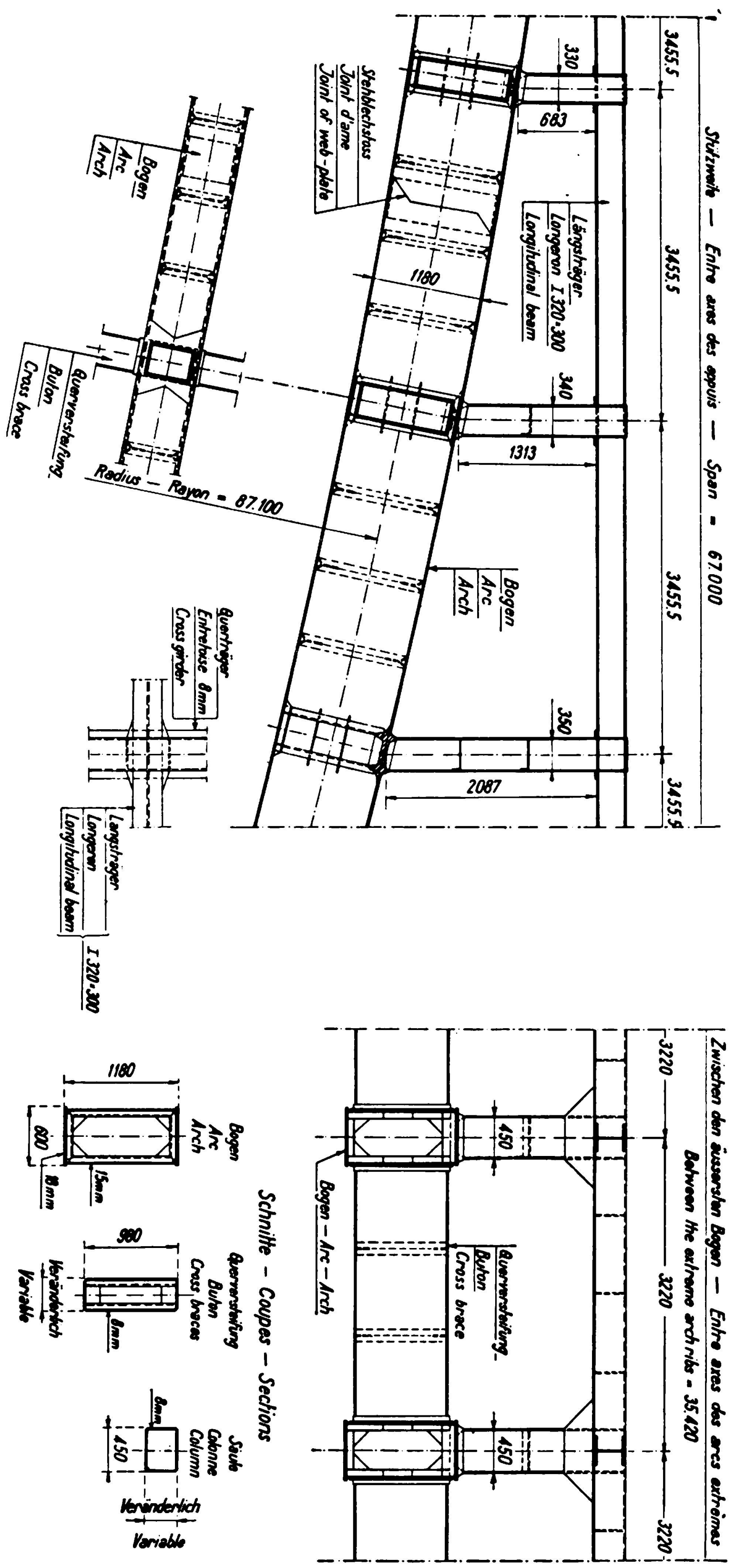


Fig. 15.
Bridge at Neuilly.

rise spaced at 3.22 m centre to centre. Each of these arches is a box section 1.18 m × 0.60 m formed by welding together four flats at right angles to one another — the box being provided with internal diaphragms formed of welded angles and flats so as to constitute cross frames. These stiffening angles are welded at their outer edges, and are spaced at one metre centres. The joint between each pair of lengths forming the arch ribs is made by butt welding, but the successive pairs of sections meet over an internal sleeve.

The arches are connected with one another by means of box shaped cross girders provided with internal diaphragms in a similar way to the arches themselves. These cross girders are 0.98 m high over the web and are formed by welding together two web plates 8 mm thick and two flange plates 10 mm thick.

The verticals are likewise of box construction, being formed by welding together at right angles four flate 8 mm thick. These are 0.45 m wide in one direction and vary in the other direction between 0.32 and 0.39 m. These verticals are spaced at 3.45 m centre to centre, bearing upon the arches through the medium of special cast steel pieces built into the upper flange of the arch.

The longitudinal girders, which are carried on the heads of the columns, consist of rolled joists 320 mm × 300 mm. The pressure is transmitted through the bracing which connects the columns together. This bracing consists of a bent plate 8 mm thick which forms a cap to the columns which it braces, and which is stiffened on the inside by flats fixed at right angles.

V. Miscellaneous Works.

11) Access bridge to rail ferry at Dunkirk.

For use in connection with the direct Paris-London passenger service, the Compagnie de Fives Lille have constructed an access bridge connecting the railway with the ferry at the Port of Dunkirk (Fig. 16). The problem of mooring the ferry, and of providing for the passage of sleeping cars from the land onto the ship, was one which involved special difficulties due to the very exacting conditions of operation. Owing to the tides there are considerable variations in level to be taken up; the transverse slope may be accentuated by

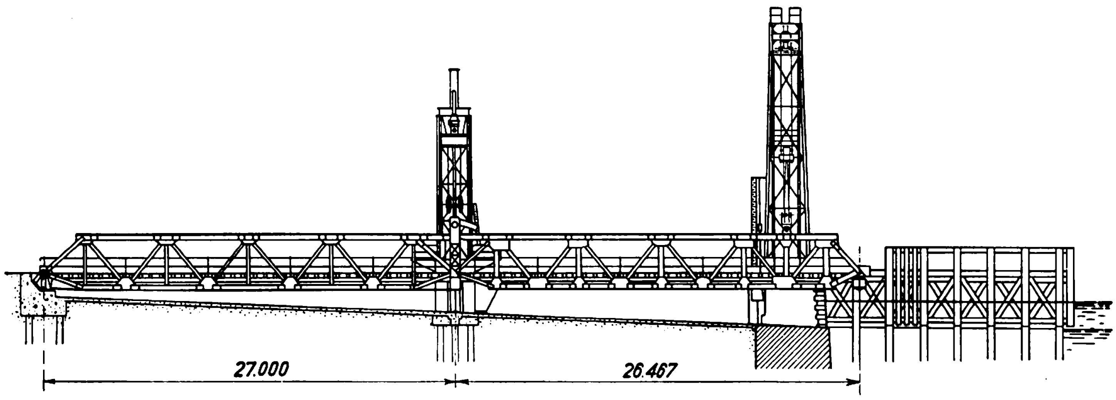


Fig. 16.

Landing Bridge for Ferry-boats, Dunkirk. Elevation.

wind and by the roughness of the water even within the harbour; finally, in view of the very crowded time table, it is essential to ensure both speed and complete certainty of operation, by night as well as by day.

These requirements have been satisfied by constructing a jointed bridge within one of the existing docks. The type is already well known in northern countries, and various improvements have here been introduced. The seaward end of the bridge is provided with a removable extension for the purpose of

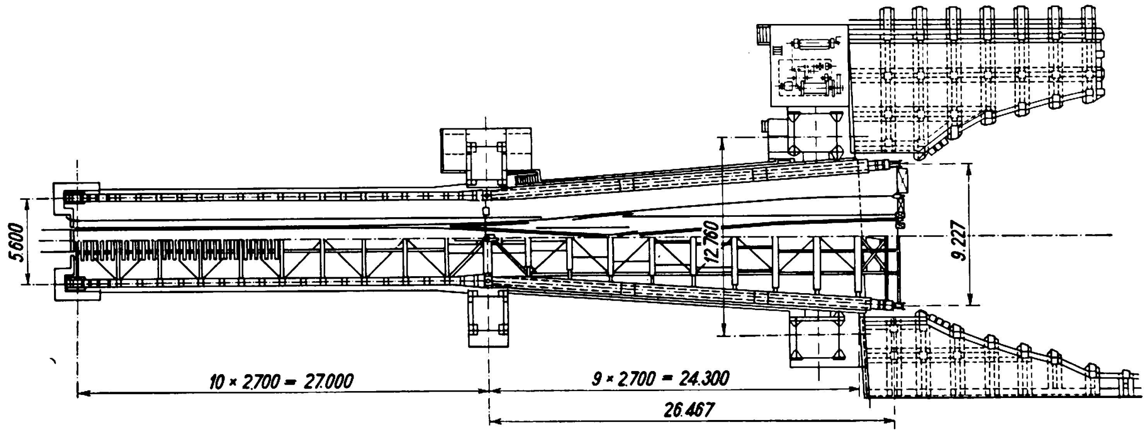


Fig. 17.
Landing Bridge for Ferry-boats, Dunkirk.
Plan.

connecting, if necessary, with the ferry now in use for the carriage of goods traffic between Calais and England, which is of a totally different design from the other.

The main dimensions of the work are, as follows: (Figs. 16, 17, 18.)

Length of the landward span 27 m.

Length of the seaward span 26.467 m.

Total length 53.467 m.

Distance between centres of girders in the landward span 5.600 m. (for one track).

Distance between centres of girders of the seaward span, varying between 5.600 m and 9.227 m (for two tracks).

Range of level of the water surface to be compensated 2.400 m.

This difference in level reaches a maximum of 3.90 m if account be taken also of the variation in the freeboard of the ship in accordance with its loading, and of the oscillations caused by a possible list which it has been assumed may amount to as much as $\pm$ 7°.

Trials carried out with the ferry on 8th September 1935 gave complete satisfaction.

12) Slipway at Lorient (Fig. 19).

For the fishing port at Lorient, in Brittany, the firm of Joseph Paris have constructed a large slipway which allows of trawlers up to 55 m in length and 650 tonnes in weight being withdrawn from the water and hauled up an inclined plane in order to place them in repair docks, of which ten are provided.

The installation consists essentially of the inclined plane, trucks for haulage corresponding in number to the repair docks, a main winch, a moving bridge and, finally, a separate winch for each of the docks.

At the top of the inclined plane, and forming a continuation of it, there is a circular pit 45 m in diameter enclosing a special type of moving bridge which

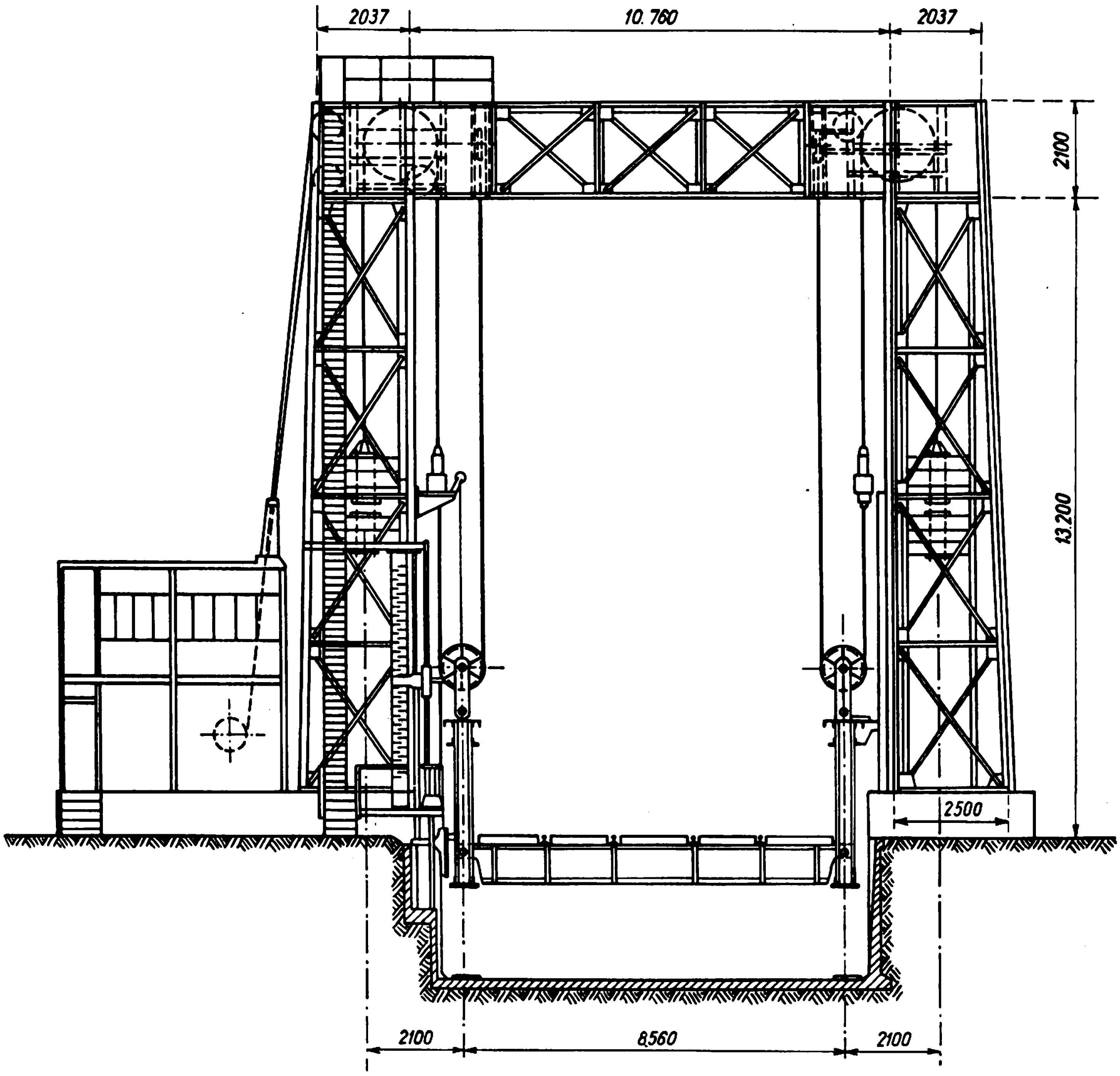


Fig. 18.
Landing Bridge for Ferry-boats, Dunkirk. End portal frames.

can both lift and turn. This bridge has rails to receive the carriage carrying the vessel, and when the latter reaches the top of the inclined plane the deck of the bridge is tilted to a slope of 6.25% so as to form a continuation of the track. The haulage is continued until the carriage covers the whole of the bridge, which then rocks back into a horizontal position. To provide for this rocking movement the main girders of the bridge rest on the pivot through the medium of suitable roller hinges, the base of which is fixed to the pivoting sub-structure. The rocking movement is imparted by hydraulic pistons which act upon a movable horizontal beam supporting the front end of the bridge;

this beam is guided, as it rises and falls, by lateral slide bars, and it can be locked in the upper position by means of screws at the side which fix it in the proper path for its movement round the circumference of a circle. When so arranged the bridge can pivot in the same way as a locomotive turn-table. The total weight of the bridge unloaded is 450 tonnes.

Ten horizontal bays radiate from the centre of the pit, forming docks in which rails are arranged exactly as on the inclined plans and on the bridge. The sub-

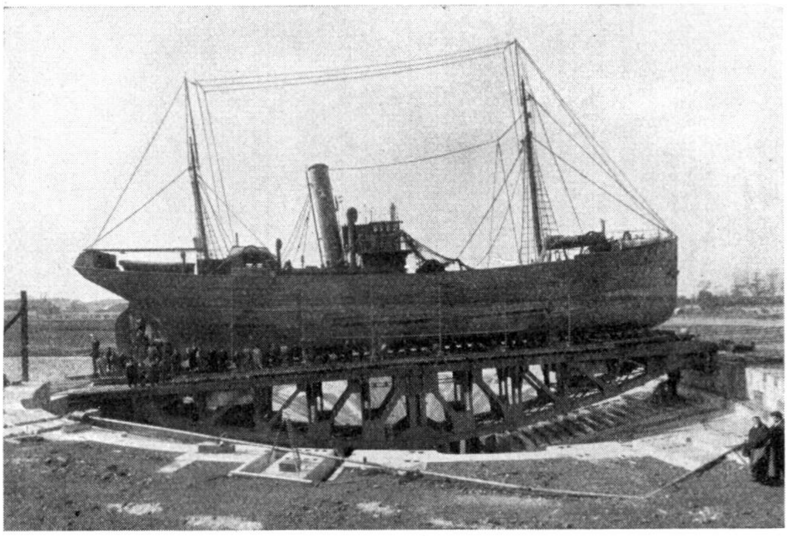


Fig. 19.
Slipway at Lorient.

structure of these bays is of reinforced concrete. None of these docks are on the axis of the inclined plane, but they are arranged symmetrically five on each side.

The bridge can be swung into alignment with any one of the docks, the turning movement being provided by special machinery carried on the bridge itself. This is worked by a 15 H.P. motor which turns a pinion at the lower end of the bridge, the pinion engaging with a rack arranged around the circumference of the rolling track. The pivot consists of a circular crown of framed construction which bears on a set of radially disposed conical rollers and is centred by a pivot rod built firmly into the masonry. When the bridge has been aligned, it is secured and finally adjusted into position by means of screws which engage with suitable seatings on the edge of the pit so as to obtain exact agreement between the levels of the ends of the rails. To remove the boat from the dock the operation of the bridge is carried out in the reverse order.

VI. Pylons.

13) Broadcasting pylons (Figs. 20 and 21).

Two years ago the French postal administration embarked upon a programme of complete renewal of its regional broadcasting stations. The power of these stations, formerly only a few kilowatts, was brought up to 100 KW and in some cases to 200 KW, necessitating the construction of aerials for effecting the radiation at high frequency with very high efficiency.

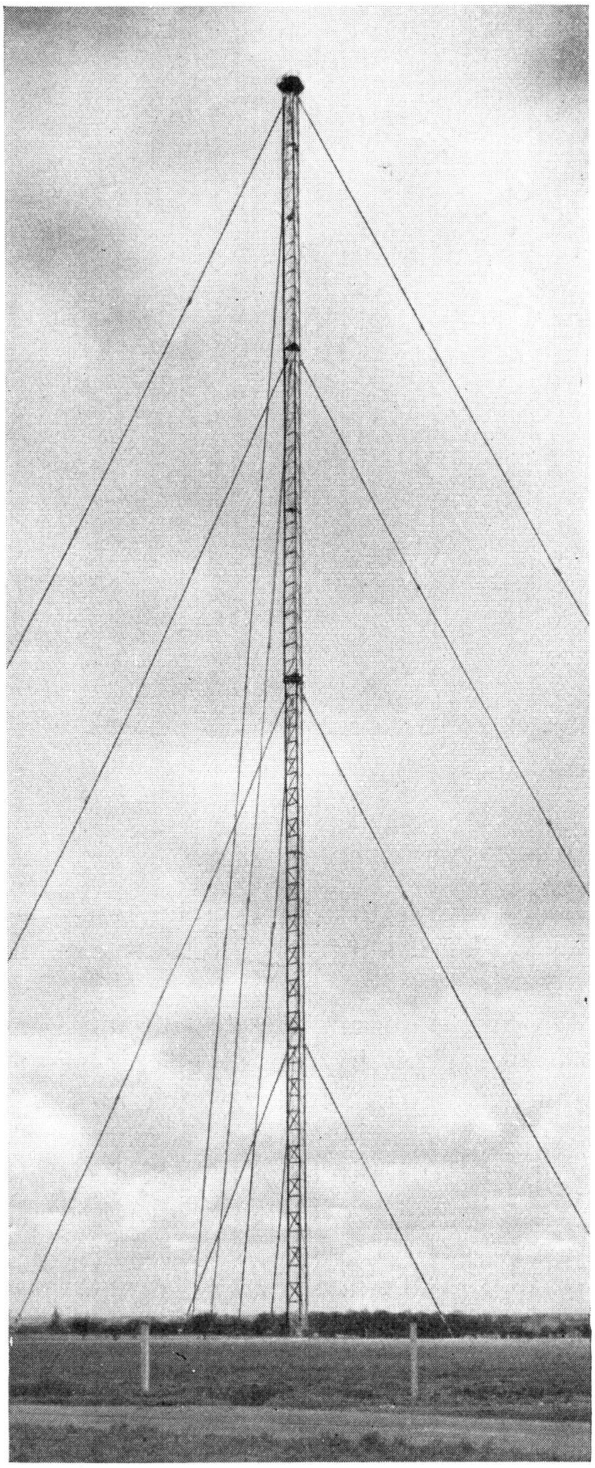


Fig. 20.
Radio Pylon.
General view.

The Administration held a competition for the supply of six pylons to comply with the following specification: —

— Height 220 m.

— Horizontal force to be withstood at the top of the pylons 2 tonnes.

— The pylons to be insulated, both at their base and at the middle of their height, to withstand an alternating difference of potential of 20,000 volts, with a frequency of 10^6 periods, corresponding to a wave-length of 300 m.

The contract was eventually entrusted to the Schwartz-Hautmont works who, before submitting their tender to the Administration, had made a rapid comparison between the tower type and the guyed type of pylon.

It having been found that the guyed solution would be the more economical, the study of this design was carried to its conclusion and a proposal was made

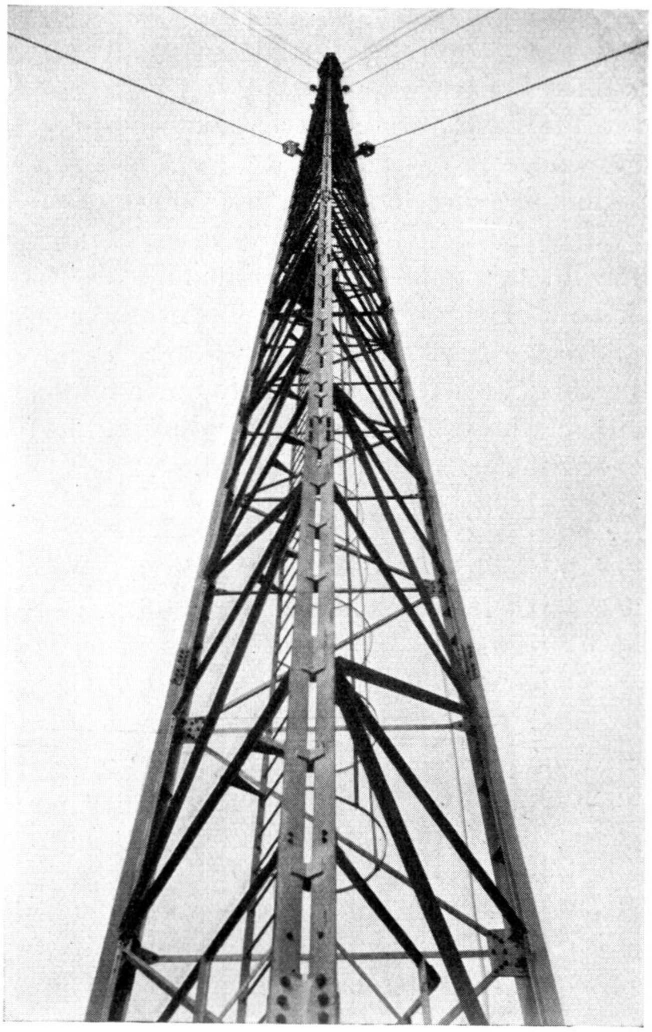


Fig. 21.
Radio Pylon.
Lattice work in detail.

to the Administration that the pylons should be built of either "54" chrome-copper steel, or in Ponts et Chaussées quality 42 kg/mm² steel with 25% elongation. The estimated cost for pylons in steel 54 turned out to be greater than that for steel 42; the difference in weight would be about 10.4%; the works cost of such a pylon would be approximately the same for either quality of steel. Considerations of economy in transport finally balanced the advantages in favour of constructing the pylons in steel 54.

This was done in the contractors' shops at Hautmont (Nord) under the direction of Monsieur Pigeaud, formerly Inspecteur Général des Ponts et Chaussées.

Calculations.

The working stresses fort steel 54, as laid down in the specification of the Ponts et Chaussées were as follows:

R 1 = 18 kg/mm^2.

R 2 = 19 kg/mm^2.

The wind pressure assumed in the calculations was 200 kg/m^2. The forces in the pylons resulting from wind pressure were determined on the assumption that the pylon formed a continuous beam on five supports. It was assumed firstly that the wind was blowing at an angle of 90^0 to one side of the pylon, secondly that the wind was blowing on two faces of the pylon in a direction bisecting the angle between the two exposed faces.

The calculations for the cables were carried out in three successive stages.

1) The pylon without wind.
2) The pylon under wind pressure, but with the points of support assumed to be locked.
3) As in stage 2, but with the connections maintaining the fixity of the centre of gravity of each pair of sections assumed to be successively released, and the pylon assumed free to turn on its lower pivot.

For the purpose of this calculation, it was found advantageous to take the co-efficient of elasticity of the cable as corresponding to its first position (see Pigeaud: "Résistance des matériaux et élasticité").

Construction (Fig. 22).

The cross section of the pylon is triangular with a constant length of side of 2.80 m. The foot is carried on a spherical pivot of cast-steel, and the pylon is maintained upright by a system of 12 guy-ropes which takes the form of three bundles of cables separated by an angle of 120^0. The inclination of the guy-ropes to the horizontal is 63^0. The three corner members of each pylon are formed from rolled angles, the scantling of which varies according to the stresses from 120 × 120 mm to 80 × 80 mm. To ensure rigidity and good resistance to buckling on these corner members, they are braced by diaphragms and bent plates attached by electrically deposited fillet welds. The guy-ropes consist of cables from 27 to 32 mm diameter. These cables are of the "Mines" type — the 32 mm cable being composed of 52 wires each of 3.52 mm diameter of galvanised and bituminised steel. The breaking strength of the steel used for the cables is between 180 and 200 kg/mm^2.

The connections between the guy-ropes and the pylon have been arranged in such a way as to approximate as closely as possible to the conditions assumed in the calculations. With this object, a platform is constructed at the level where the cables connect with the pylon, consisting of beams framing the equilateral triangle which forms the section at that level. The cables are attached at an axis 220 mm away from the vertical axis of the pylon, an arrangement which serves considerably to diminish the bending moments which may result from variations in the tensions as between the guys attached to any one crown, and also to ensure that the vertical components of the loads in the cables of a given crown are distributed almost uniformly, owing to this arrangement on three corners of the pylon.

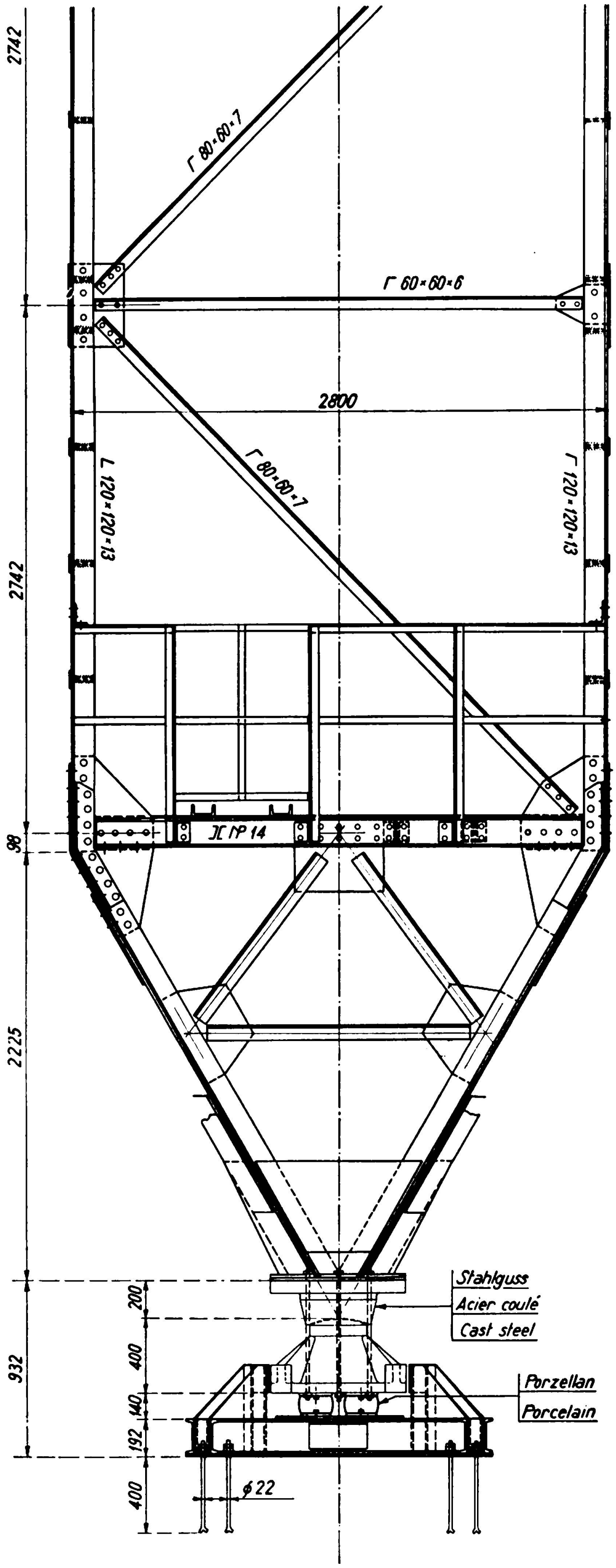


Fig. 22.
Radio Pylon.
Base of mast.

The insulation at the base has been carried out by means of a hoop of porcelain 90 mm high as illustrated in Fig. 22. Each of these porcelain members can carry a maximum load of 90 tonnes, and their dimensions have been calculated with a factor of safety of three. At the level of 110 m, in order to obtain the insulation by using porcelain as the insulating material, special measures have had to be taken in view of the fact that porcelain will withstand only compressive stresses. Some idea of the resulting complication of the framework may be gathered from Fig. 25.

At every 50 m the guys are interrupted by an insulating device, wherein the tension of the cables is transformed into compression exerted on blocks of porcelain, this being the only form of stress which the latter material will withstand.

Finally, to complete the electrical insulation, the ladder which gives access to the upper platform of the pylon itself rests on blocks of porcelain, and is divided into sections joined by blocks of porcelain.

Erection:

After trial assembly in the shops, the pylons were delivered in sections and these were erected one over the other with the aid of a tubular mast 10 m high, fixed at the centre of the pylon by means of cables suspending it from the three sides of the latter. The mast was moved from one level to the next within the pylon.

The sections were lifted into place with the aid of a mechanical winch. In the course of the erecting operations the pylon was maintained vertical by temporary cables, the tension of which was controlled by dynamometers so as to avoid the production of oblique stresses in the blocks of porcelain (as will be discussed below). At as early a stage as possible the guy ropes were added and were subjected to an initial tension, calculated with a view to reducing the oscillations of the pylon in the wind. This tension was checked by dynamometers of up to 30 tonnes capacity.

Foundations:

The foundation under the pivot is formed of a heavily reinforced concrete slab.

The tension of 30 tonnes in each of the guy ropes is absorbed by an anchorage of the "Malône" type, which consists of a pile inclined in the direction of the cable and having a length proportional to the tension in the latter and to the resistance of the ground; at the foot of the pile a spherical chamber is hollowed out, and this, like the pile itself, is filled with concrete; steel bars are embedded in the concrete and the cable is attached to these. With this arrangement the volume of earth intervening between the spherical chamber and the surface of the ground acts as an anchor weight.

VII. Dams.

14) The Chatou Dam (Seine):

A composition was held by the Administration des Ponts et Chaussées for the reconstruction of a dam across one of the branches of the Seine at Chatou, below Paris. The Moisant-Laurent-Savey works, who were awarded the contract, have completed a modern form of installation which is of special interest in view of the various novel features and improvements incorporated.

The work includes three weirs of similar design, each with a clear width of 30.50 m wide between the faces of the piers and abutments, and as the piers are each 4.50 m wide, it follows that the total width of the dam between the neat faces of the two abutments is 100.50 m. The span of the gates between supports is 32.40 m.

The crest of the three weirs is at a Reduced Level 15.50 m. Each of the weirs is closed by an arrangement consisting of a lower and upper gate which can be moved vertically by machinery. The upper gate is provided with a device which allows it to be lowered in stages in the event of a slight flood, but for a large flood the whole of both gates is removed.

The gates, when completely lifted, leave the weirs unobstructed up to R. L. 31.00 m so as to permit navigation, for which provision is normally made in time of flood, up to level 25.00 m.

A high level service bridge is provided on the upstream side along the whole length of the structure. This carries the machinery for operating the gates and also serves as one of the tracks for a double travelling gantry to which reference will be made below.

To allow passage on the upstream side of the gates when at full capacity, three moveable gangways resting on the piers and abutments are provided at a height of 0.80 m above the water level of 23.22 m. These gangways, which rise and fall automatically with the lower gates, are completely free of the weirs when the gates are lifted. The gangways were originally designed in ordinary steel but have actually been constructed in high tensile steel, as a trial of this new material.

On the upstream side of the gates vertical grooves have been formed in the piers and abutments for the attachment, if and when necessary, of a mobile metal cofferdam made in a single piece, forming a temporary substitute for the gates of any given opening in case of damage and allowing their removal and repair.

The cofferdam can be brought into position by means of a double travelling gantry which spans between the service bridge on the down stream side and a track formed on a reinforced concrete box girder on the upstream side. On the left bank these tracks are continued across an additional span reaching the island of Chatou, where the cofferdam is normally kept when not in use. The gantry can likewise be used in case of repair work to pick up any of the gates or gangways and deposit them on dry ground on the island.

Downstream of each weir, a cavity has been formed to receive a cofferdam composed of four pieces which are normally stored on the island of Chatou: this, again, can be moved about by means of the gantry. This downstream cofferdam, erected opposite any one of the openings conjointly with the upstream cofferdam, would enable the space between them to be pumped dry for effecting repairs to the gates, the grooves, or the crest of the weir. The necessary operations can be carried out either by electric winches or by hydraulic jacks.

The downstream service bridge consists of a gallery which extends over the whole length of the works, consisting of three weirs and one span over the island. On the right hand side of the piers and abutments, this gallery is built higher, forming cabins which contain the hydraulic jacks. The roof and upstream side of each of these cabins can be completely removed when it is required to erect or dismantle any apparatus by means of the travelling gantry.

The upstream bridge consists of a tubular girder which carries a track of 1.28 m gauge for the bogies of the travelling gantry. The downstream and upstream bridges are connected at their two ends by horizontal struts which, with their seatings, form cross-frames.

Between the two bridges the piers and abutments are splayed, down to level 30.50 m, to allow the passage of the gates and cofferdam when these are being transported by the gantry.

The span over the island where the gantry is normally stored has a clear opening of 35 m, allowing the upstream cofferdam or the gates to be easily stowed away at ground level between the piers, and the downstream cofferdam in four pieces on suitable supports on the downstream side.

The gates are of the Stoney type, made of steel, and the weight of the upper gate is 100 tonnes.

The end of each gate is bolted to a cast steel rolling frame so arranged as to allow the horizontal bending of the gate under the pressure of the water. This frame presses against a series of rollers which transmit the pressure onto a cast steel track built into the grooved masonry. The set of rollers is suspended from a pulley block which is carried between two passes of steel cable, one end fixed into the masonry and the other attached to the head piece of the gate. This is the characteristic arrangement of the Stoney gate, whereby friction is reduced to a minimum, being purely rolling friction.

Since the suspended rollers move at a speed half that of the gate, a point is reached in the upper part of the travel of the gate when the latter ceases to be supported by these rollers; at this point it is picked up on fixed rollers built into the masonry. On the upstream side, guidance is afforded by means of fixed rollers at either end of the frame, rolling on a vertical track formed of I section, which is held in position by horizontal attachments built into the concrete. To allow of withdrawing the gates for repair, the I-shaped section on the upstream side includes two portions which can be removed to leave a free passage for the rollers projecting from the gate when the latter is suspended from the gantry and is being moved sideways.

The lower gate is hung at each end from a double chain of steel with flat links, the two runs of this chain being connected to it through an arm linked with a block forming part of the frame of the gate. The two parts of the chain are connected above to a hydraulic jack.

The upper gate is suspended from a rigid tie-rod attached to the top of the frame but free to hinge within the latter when the gate has a movement imparted to it by the other gate. This rigid tie-bar terminates above in a Galle chain tackle, one end of the chain through the latter being attached underneath the upper service bridge and one end coiled on a reel which forms part of the mechanical winch.

The lifting mechanism includes two separate arrangements, one for lifting of the upper gate by itself and the other for lifting the lower gate or both gates together. The mechanism for the upper gate consists of an electric motor of

30 H. P. which operates two winches of 100 tonnes capacity each, through a cross shaft. The rate of lifting is 0.20 m per minute. In the case of the lower gate, the lifting arrangement consists of two hydraulic jacks of 175 tonnes capacity.

VIII. Aircraft Hangars.

15) Hangars at Bordeaux-Teynac (Figs. 23 and 24).

The steel hangars, in the aerodromes of Bordeaux-Teynac and Lanvéoc-Poulmic constructed by the firm of Daydé, form part of a servies of 27 hangars to be built on a patented system jointly by this firm and be the Forges et Ateliers de Construction Electrique de Jeumont. They have a free opening of 70 m with a depth of 66 m at Bordeaux-Teynac and 55 m at Lanvéoc-Poulmic. The clear height inside is 10 m. The framework is carried on concrete footings which extend to 1.50 m above ground level.

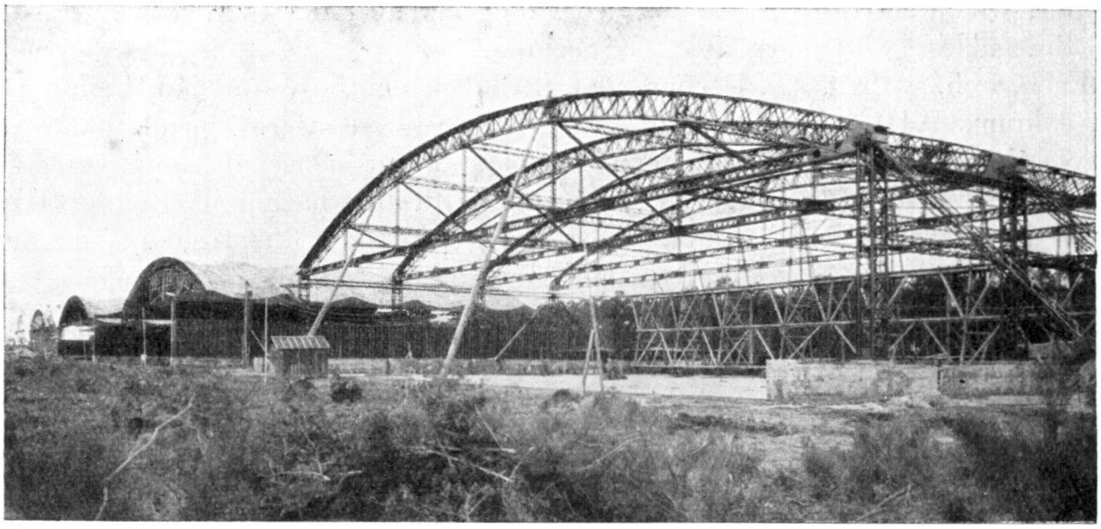


Fig. 23.
Aircraft Hangars at Bordeaux-Teynac. Frame work.

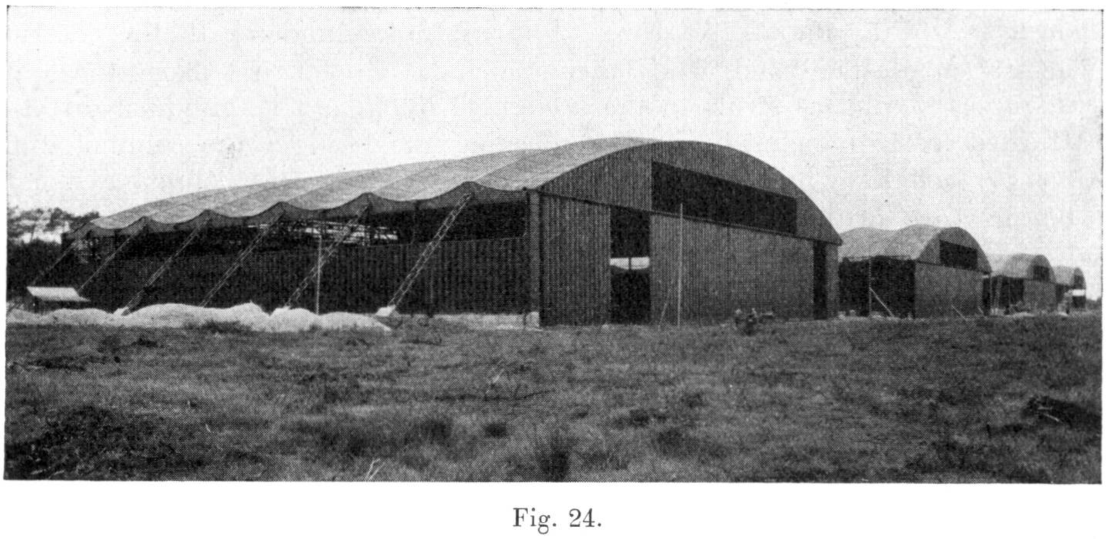


Fig. 24.
Aircraft Hangars at Bordeaux-Toynac. View of completed structures.

In the case of the 66 m hangar the framework consists of six intermediate arches relieved by ties of 71 m span spaced at 11 m centres. These are carried on vertical piers. There are also two end frames of similar span, with struts and bracing, a roof covering of sheet metal, filling and covering pieces for the two long sides and the closed end, and sliding doors for closing the open end.

The construction of the 55 m hangar is the same, with the exception that one of the intermediate arches and one span of 11 m are omitted.

The arches each consist of a lattice girder built with its axis in the shape of a circular arc, and having a rectangular cross section 1.50 m high by 0.80 m wide. The rise, measured at the axis, is 7.60 m. The ties are box girders, 0.50 m by 0.58 m, enclosed by lattice work on the vertical sides and by full plates on the horizontal faces. Each tie is connected to the corresponding arch by five latticed suspenders, and the ties are braced by five sets of box girders which serve to resist laterial buckling and to unify the two wind girders of the gables (which are described below).

Each arch, with its tie, is connected at the springings by pin joints supported on columns 9.10 m high, one of these serving as an inverted pendulum which leaves the arch and tie free to expand under the influence of temperature and loading, while the other is fixed by an inclined strut having its footing 10 m away from that of the column, either to the left or to the right of the shed.

The covering, which is the especially original feature of these hangars, consists of a self-supporting roof formed from sheeting 1.4 mm thick erected in pieces 2.50 m by 10.20 m welded together. Each such sheet is hung from its ends between two successive arches and is given the shape of a hyperbola by stiffening members 0.160 m high. Thus the roof is made up of a succession of sheet metal "tents" in the shape of hyperboloidal segments having a common horizontal axis parallel to the long sides of the shed.

In the case of the intermediate arches the tensions exerted by the strips of sheeting are balanced as between those on either side. At the two ends of the shed the sheets are terminated at the circles which fit the corresponding hyperboloids, and the tensions imposed by the sheets across the end arches are balanced by the action of five rows of thrust pieces underneath the covering.

The system of struts and wind bracing includes, in the first place, the upper thrust pieces serving as struts to the arches. Stability in a longitudinal direction is afforded by two inclined braces connecting the head of the column at the middle of each long bay with the feet of the two adjacent columns.

The pressure of the wind against the sheathing at the closed end of the shed, or against the sliding door, is transmitted to these bracings and to the middle columns through the medium of two horizontal triangulated wind trusses which are arranged against the long sides of the shed in the plane of the bracings of the ties of the arches, and through the medium of two wind girders placed against the gable ends.

The sheathing of the long sides consists of rolled sheets 1.4 mm thick, arranged in courses 2.40 m high. These are carried on small walls of reinforced concrete 1.50 m high and terminate at the top in a glazed strip 2.70 m high.

The sheathing at the closed end is formed in similar fashion to the long sides, with glazing over 35.50 m length of the shell.

The open end can be closed by a sliding door made up of 15 panels 10 m high. These travel on rollers in tracks built into the foundation at the bottom, and are guided by tracks attached to the framework of the hangar at the top.

These hangars have been constructed entirely in high-tensile steel. Their erection was carried out on moving scaffolds with the aid of a pivoting 3 tonnes electric crane of 9.50 m reach, the crane itself running along the top of the scaffold. The erection of a hangar of 540 tonnes weight was completed in 24 days.

16) Another type of aircraft hangar (Fig. 25).

The firm of Delattre et Frouard have perfected a new system for the construction of self-supporting roofs using thin sheet without any framework, and three hangars designed in accordance with these new methods have been ordered by the (French) Air Ministry.

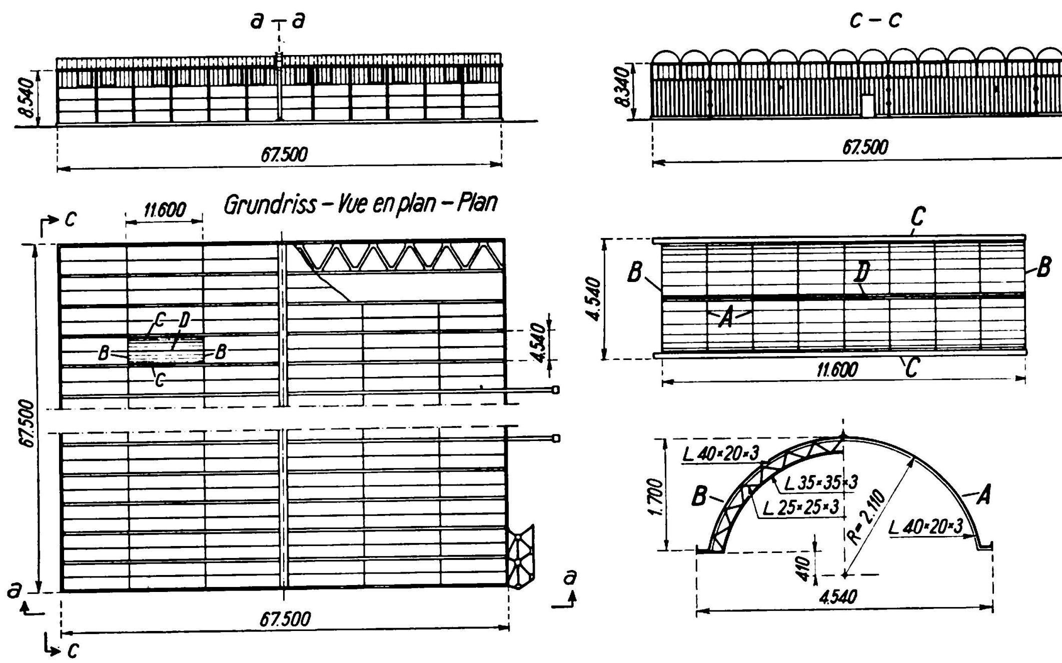


Fig. 25.

Aircraft Hangars built by Messrs. Delattre et Frouard.

General characteristics: —

The useful area (internal measurements) is 67.50 m square, equal to 4556 m². The useful height is 8.50 m. The hangars are capable of being taken completely to pieces. Apart from the joints arranged for this purpose, which are bolted, the whole of the remaining construction is assembled by electrically welded seams.

a) Roofing —

This consists of 15 identical elements which act as girders continuous over three supports. Their intermediate support is afforded by a central girder, one end of which rests on an internal column situated 22.50 m from the front face.

and the other end on a column in the back face of the hangar. The outer supports are columns situated in the long sides of the latter, these columns being standard 220 mm I-sections. The roofing element is a half-tube of 3 mm sheet bent to a radius of 2.10 m and having welded to it two side channels of 3 and 4 mm sheet. The "half"-tube is not a complete semicircle, but its central angle is 150⁰ and its rise is 1.70 m. The side channels are 20 cm wide and the total width of the arch including these channels is 4.54 m.

Each separable section, approximately 11 m long, consists of eight sheets butt-welded to one another, and two such sections joined along their common upper generatrix form a complete roofing element with channels. Six of these elements constitute a complete girder over three supports. Stiffeners formed of $40 \times 20 \times 3$ mm angles bent to the required shape are welded to the sheeting at approximately 75 cm intervals; every fourth stiffener is replaced by a curved lattice frame, likewise welded to the sheet, consisting of an upper flange of $40 \times 20 \times 3$ mm angle, a lower flange of $35 \times 35 \times 3$ mm angle, and lattice work at 45^0 of $25 \times 25 \times 3$ mm angle. The front and back facing members include box girders in the plane of the channels; these are of triangular lattice construction around the half-tube, which is thus made to act as a wind girder.

b) Central girder.

The central girder consists of two plate web girders 2.10 m high and 80 cm apart. The webs of these, 5 mm thick, are stiffened by $60 \times 40 \times 5$ mm and $60 \times 60 \times 6$ mm angles spaced 30 to 50 cm apart. The booms are made from half I-sections with very wide flanges 280×280 mm reinforced by plates up to 260×24 mm at the point of maximum bending moment.

The twin girders are strutted in the first place by the arches themselves which are continuous through the webs of the girders (portions oft them being welded to either side of the web plate) and in the second place by latticed trimmers spaced at an average distance of about 4 m.

The front column is of V-section, being formed of two box girders, with a pin joint at the foot. The rear column is also of box construction and is pin-jointed in both directions at the top and at the foot.

c) Long sides.

These are built in corrugated sheeting 0.8 mm thick attached to longitudinal members (80 mm standard I-beams) resting on the columns. The uppermost 2.50 m of the sides is glazed and one-third of the glazed area is on opening sashes. The sides are borne by dwarf walls of reinforced concrete 50 cm high.

d) General stability.

This is ensured by side bracings at an inclination of 7/8, and by the central girder as regards stability in depth.

e) Doors.

These consist of panels on ground rollers which run into a suitable place at the side. The panels are formed from pressed plates.

f) Total weigtht, without the sliding doors, is 283,000 kg or 62 kg/m².

g) Materials used.

The whole of the hangar is constructed from sheets and rolled sections of "steel 54" having an elastic limit of 36 kg/mm² and a breaking strength of 54 kg/mm². Only the sheathing, 0.8 mm thick, is of mild steel sheet.

Summary.

One of the most pronounced characteristic in the activity of French steel designers lies in their research work and development of improved and modern construction methods with the object of reducing prime costs. The present article gives a number of descriptions of recent constructions illustrating the advance made in various fields of structural engineering in steel. The author's report is divided into 7 sections, giving a description of 15 structures in steel.

1) *Structural steel work.*
Shell Building in Paris, Medical Faculty in Lille, Rex Cinema in Paris, New Citroën works in Paris.

2) *Riveted Bridges.*
Bascule Bridge in Dunkirk, Moissac Bridge, Viaduct La Rochelle-Pallice.

3) *Welded Bridges.*
Bridge near Porte de la Chapelle in Paris, Bridge in Soissons, Bridge in Neuilly.

4) *Various Structures.*
Railway-ferry-bridge in Dunkirk, Slipway at Lorient.

5) *Pylons.*
Broadcasting tower of P.T.T.

6) *Weirs.*
Weir at Chauton (Seine).

7) *Airplane Hangars.*
Hangar at Bordeaux-Teynac, Hangars with self-supporting steel plating.

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