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Autor: Shimizu, K.
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3. Radio Transmitting Antenna Mast (Japan)

Owner: *NHK (Japan Broadcasting Corporation)*
Engineer: *NHK Engineering Headquarters, Architectural Engineering Division Staff*
Work duration: *7 months for fabrication*
4 months for foundation
4 months for erection

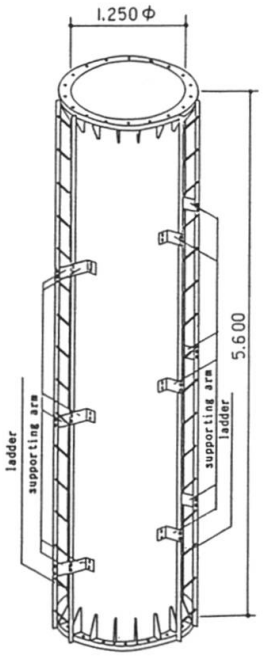
Dimensions:
Mast height: 240 m
Kind of steel: SS 41 (JIS)
Kind of pipe: STK 41 (JIS)
Diameter of steel pipe: 1.25 m
Thickness of steel pipe: from 1.2 to 1.4 cm
Diameter of top hat: 12 m
Kind of ropes: spiral rope (JSSC)
Diameter of guy rope: from 40 to 46 mm
Breaking stress of guy rope: 150 kg/mm

This antenna has been constructed for the use of the radio broadcasting services. It is located 40 km north of Tokyo. The output power of the broadcasting equipment is 500 kw and its coverage is about 13 million households. The antenna mast, made of steel pipe, ist 240 m in height. The mast consists of 44 steel pipe components with flanges at both sides, and these flanges are jointed by bolt-nuts. It is supported at seven stay positions by guy ropes, which are tensed in three directions at each position.

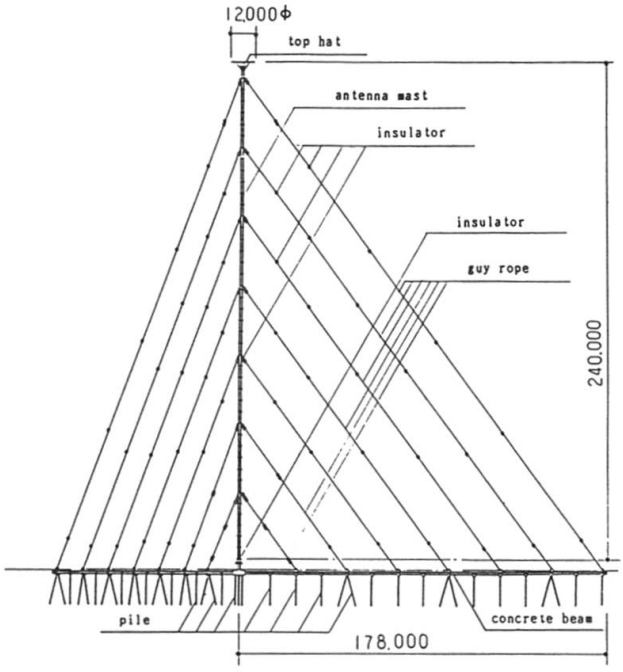
As the mast is an electric antenna in itself, its base is separated electrically from the earth by insulators. In the similar way as the mast, every guy rope is insulated. In the design of the antenna, there were the following two problems to be solved:
- how to reduce the vibration of the mast due to Karman's turbulence caused by wind,
- how to build the mast firmly on the soft ground.

Generally, a guyed mast is made so slender that it lacks stiffness. Therefore, the mast is apt to resonate structurally in accordance with its diameter even in low speed wind. Owing to this phenomenon, structural defects occurs occasionaly, and these bring a loosening between bolts and nuts and cracks at welded seams. In order to solve this problem caused by Karman's turbulence, supporting arms for ladders are fixed spirally along the mast. The arms are made bigger than for ordinary use. Three ladders are fixed to them. As a result of this counter measure, streams of air are disturbed and the occurrence of the cyclic Karman's turbulence is kept down. Consequently, the antenna mast has been stabilized. Therefore, there is no need for dampers on the guy ropes.

As for the other problem, a continuous foundation method was adopted instead of discrete anchors. As ground with high conductivity is suitable with respect to the propagation of an electric wave, soft ground was selected as the site for the radio antenna. Another reason is that large soft ground sites are relatively easy to find. Ordinarily, anchor blocks for guy ropes are made of concrete. In the case of soft ground, blocks of concrete are not economical because they need many diagonal piles to resist displacement by the horizontal component of guy tension and deformation by earthquakes.



A steel pipe component



Antenna mast

On account of this, continuous concrete beams were used instead of blocks of concrete. The directions of three beams coincide with those of the guy ropes.

These beams are joined at the foot of the mast. The guy ropes are joined to the beams at regular intervals so that the weight of the beams resists the perpendicular components of guy tension. In this case, the horizontal components change the axis forces. All three forces cancel each other at the center.

By taking these measures, an economical and highly resistant antenna tower has been realized.

(K. Shimizu)