

## CONSTRUCTION ANALYSIS OF JIB TOWER CRANES

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*The construction boom of tower cranes. The analysis of foreign and domestic literature dos lidzhen on construction of jib cranes. Examples of models of tower cranes with their images.*

***Jib system, flight, construction, crane.***

**Formulation of the problem.** In tower cranes, jib systems designed for the holding and movement of goods within the required service area [1]. There is a great variety in design of jib tower cranes, which are currently the most effective in terms of design, operation and installation, as they are widely used around the world. But to find out what conditions of elected or other construction boom systems. Advantages and disadvantages of structures jib tower cranes are considered in this study.

**Analysis of recent research.** In [1-5] considered part of the construction boom cranes. For example in [2] described the history of tower cranes ranging from cranes with a lifting boom of the 1940s. In [3, 4] The construction hinge-articulated jib of tower cranes. Review of construction tower cranes for special work was carried out in [5]. Construction cranes that produced in the Soviet Union are in the reference [6].

**The purpose of research.** To analyze the construction of jib cranes.

**Results.** The first cranes were fitted with lifting boom system. In Europe, after the Second World War, have been developed various designs including tower cranes tower cranes on rail excavators with a rotating turret and boom lift were dominant. The most popular were Liebherr crane production and Peiner [2].

However, in the late 1960s French taps horizontal Povia negotiable boom began to replace traditional boom cranes with a lifting and rotating turret. Such designs earlier models

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producer company Potain (Fig. 2), Weitz, and later became the most popular Richier. Other European manufacturers followed this trend. Thus the share of tower cranes with a horizontal swivel boom has increased from 30% in 1968 to 90% in 1972.

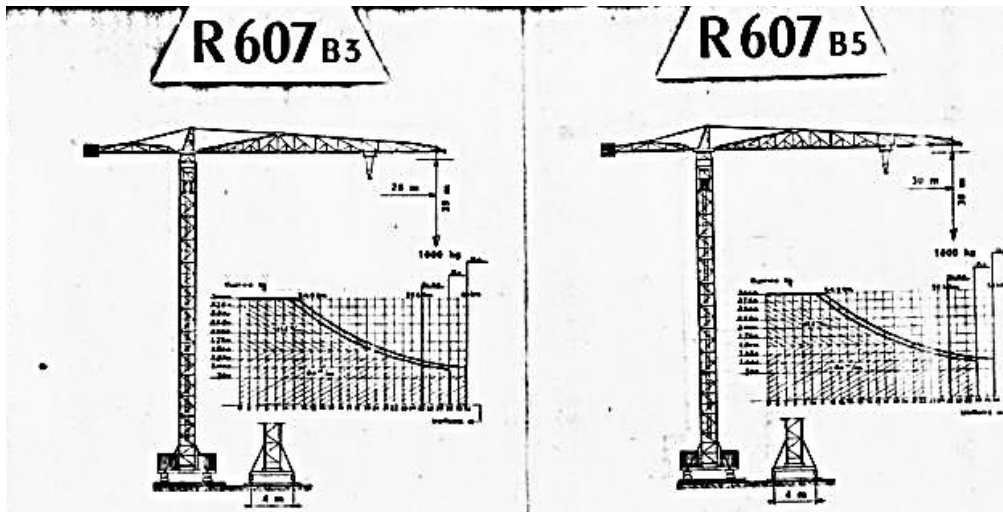


Fig. 1. Tower cranes Potain R607 B3 and R607 B5.

In 1958 Liebherr introduced the "universal tap" slewing tower crane with a lifting boom with hydraulic flight changes (Fig. 2a). HB Series cranes with load moment 300 kNm to 90 kNm had a small minimum radius, allowing multiple cranes working near high-rise building construction. Such a tower crane with a lifting boom swivel and equipped with a movable counterweight which was set in motion with the help of a rope and diesel hydraulic change departure was represented by Favco in 1964 (Fig. 2b). These cranes worked with load moment 1,000 kNm.

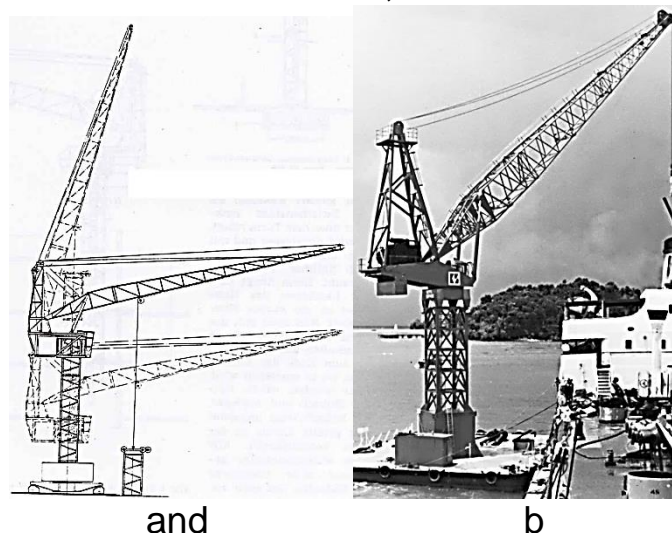


Fig. 2. Tower cranes with a lifting boom, and- Liebherr 500 HC-L; b - Favco STD350.

Favco biggest development came in 1966 with the crane Climbing STD 2700 450 kNm. Eight of these cranes, the ancestors of the later cranes with a lifting boom, helped build the World Trade Center in New York (Fig. 3).



Fig. 3. Tower cranes FavcoSTD 2700.

Building construction in densely populated cities in Asia require high maneuverability of the tower crane. This led to the development of many types of construction tower cranes with a lifting boom on maneuvering almost every European manufacturer of tower cranes. Sophisticated mechanical solutions which tried to balance the load moment of the boom system when changing departure. Traditional mobile, using ropes, counterweight has been replaced by a massive counterweight swinging cranes Liebherr 500 HC-L in 1985 (Fig. 4a).

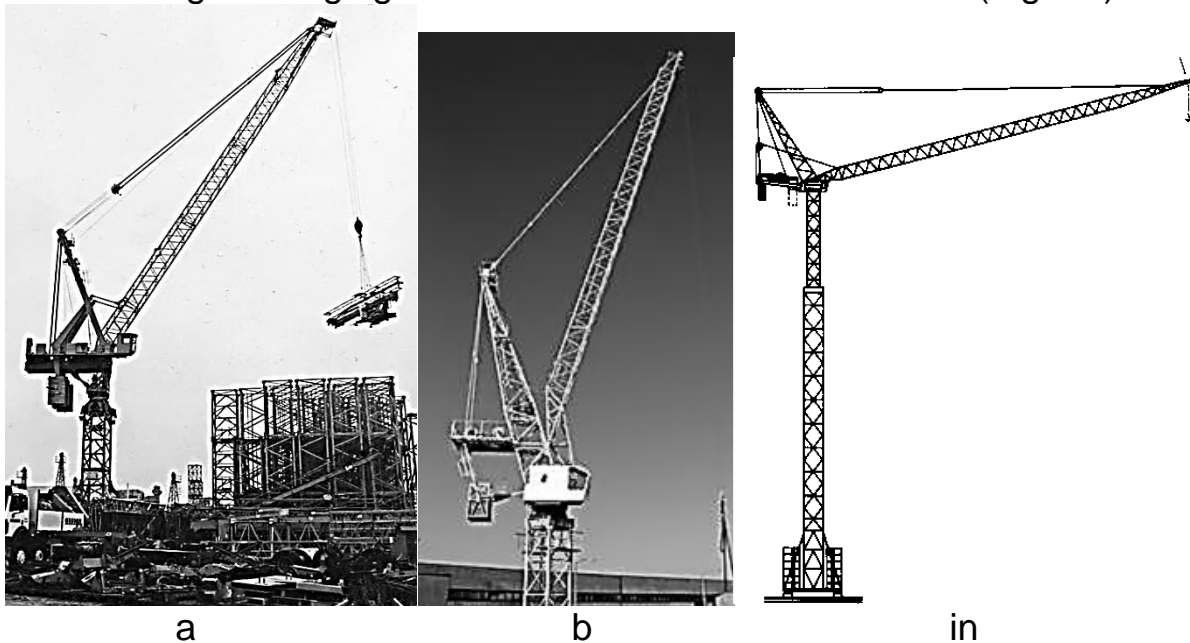


Fig. 4. Tower cranes with a movable counterweight: a - Liebherr 500 HC-L; b - BKT CTL 400; in - Potaine MR300.

BKT used almost the same way in balancing models crane load moment 750 kNm, but later found a safer and easier solution. In 1997 Comedil introduced the mechanical connection between the counterweight and boom which took place under the turntable in Tower Crane CTL 400 (Fig. 4, B).

More complicated balancing system was developed and implemented in Potaine in 1989 to counterbalance the crane MR300 which moves along the inclined guides and financed by rope (Fig. 4, B). When lifting boom counterweight close to the tower on inclined rails.

In the 1990s, most manufacturers of tower cranes in Europe refused to expensive and complex method of balancing the lifting boom by moving the counterweight.

Tower cranes with a lifting boom system have a number of drawbacks: the impossibility of strictly horizontal movement of cargo at the change of departure; about the need to increase capacity for lifting the boom and cargo in the event of change of departure; relatively large minimum radius; significant dynamic loads that occur during transients movement that leads to the buildup of cargo. However cranes with lifting boom maneuvering system, which allows their use on small construction sites, they are easier to transport and assemble. Weight lifting boom system 15-20% less compared to the beam. Also cranes with the boom system used for the construction of high-rise buildings, where much of the work cycle of lifting cargo holds, compared with a change departure.

Girder boom systems are *odnovidvisnyy* (Fig. 5) to *dvovidvisnyy* (Fig. 5, b) and *bahatovidvisni*. Such boom system were spread on modern cranes with large departures (over 45 meters). Also used *molotopodibni* arrows (Fig. 5, c) although the weight they slightly exceed suspended. Their advantage is the simplicity of calculation and use. The main disadvantage beam jib systems is low flexibility, they are inconvenient to use on a small (limited) construction sites.

Maschinenfabrik Otto Kaiser KG, later integrated into the Elba plant has developed an unusual concept crane series Kaiser HBK (Fig. 6a), which in 1960 - 1970 was tested very successfully.

This tower crane swinging boom combined with the advantages of a tower crane with horizontal and lifting boom. The main criteria for the design of the valve assembly was possible horizontal arrow with a small radius. When laid boom system of truck cargo moves along the entire boom system and provides maximum radius. When the boom system changes the flight radius becomes excessive increase in lifting height in minutes without the installation of additional sections boom system. The construction boom of this system is particularly useful for the construction of cooling towers, television towers and skyscrapers. Compared with tower crane with a lifting boom of this design allows to perform horizontal movement of cargo and spend less energy when there is a change of departure when moving trolley. The main disadvantage is relatively low load to a minimum radius of a raised boom.

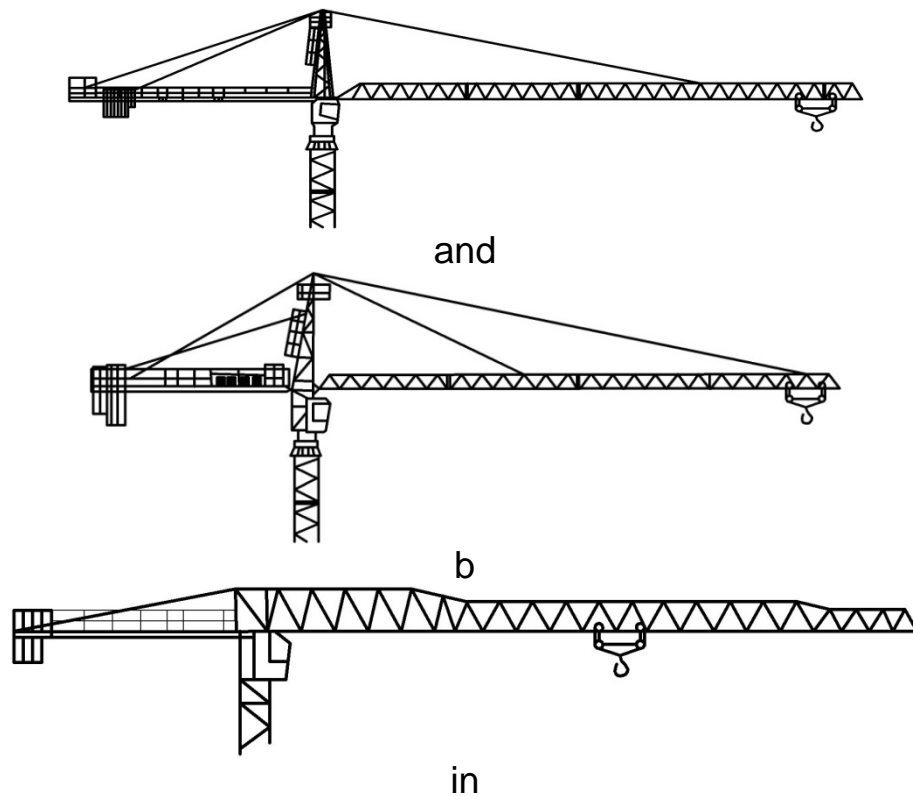


Fig. 5. gibbet girder system: a - odnopidvisna; b - dvopidvisna; in - molotovydna.

Kiser cranes were equipped with an inclined turntable for the construction of towers and tower sections reaching 12 meters in height. Many high-rise construction projects, such as the 331.4 m (Frankfurt television tower) and large cooling towers were built cranesKaiser HBK. During the construction of the bottom of the towers when you need to achieve great departure jib tower crane system is stretched in a horizontal line. A narrow construction at the top of a large cooling tower range is no longer needed because the boom system is thus increasing lifting height. And Liebherr Peiner (Pecco) prosliduvally for tower crane with hinge-jointed system Kaiser. Among these flagship brand Liebherr crane model was 180 HC-K, used for the construction of 150-meter towers in Switzerland in 1977. Another well-known crane with hinge-jointed boom system Liebherr 140 HC-K is widely used in urban construction sites (Fig. 6 B). Peiner had only one crane with hinge-jointed boom system marks SKK 140 (Fig. 6,) that without additional fasteners could be reduced to a height of 84.4 meters.

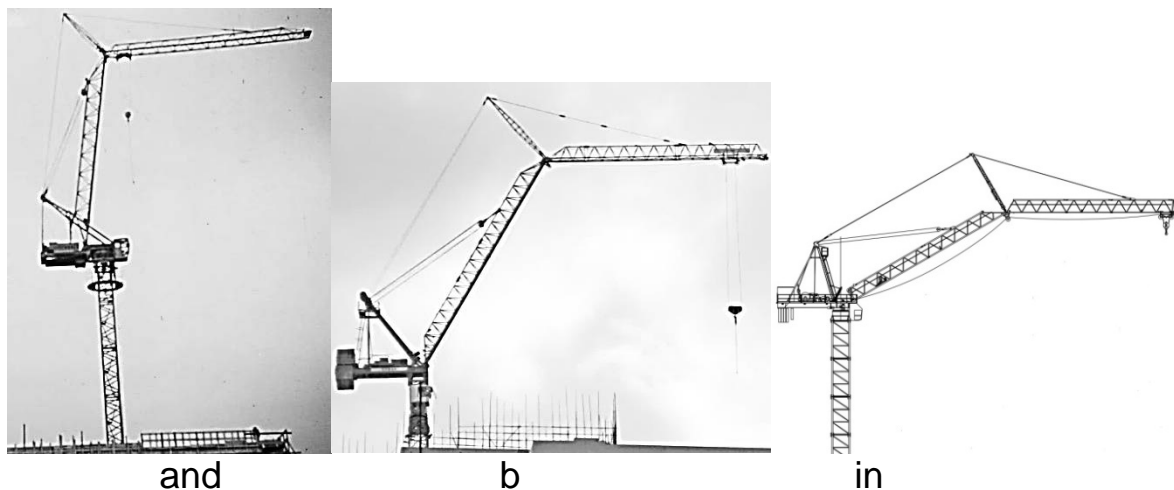


Fig. 6. tower crane models with hinge-jointed boom system, and- Kaiser HBK 90; b - Liebherr 140 hc-k; in - Pecco SKK140.

In 1969 he was drafted tower crane with a hinge-jointed boom system CSC-250 (Fig. 7). Jib system which has two horizontal position and difficult when the main section of the hinge-jointed boom system installed horizontally and utility at  $30^\circ$  to the horizon. [6] In this position, can significantly increase the lifting height. Thanks to a special scheme provided zapasovky cargo rope horizontal movement of cargo by driving trolley down an inclined boom.

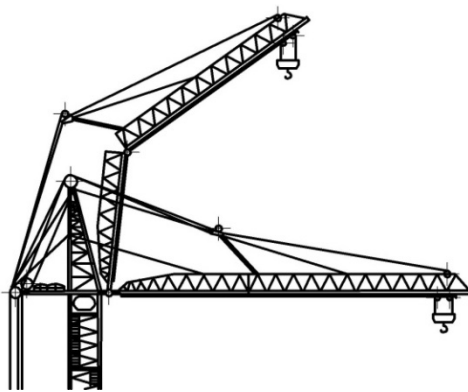


Fig. 7. Tower crane CSC-250.

In the early 1960s, the Swedish company Tornborgs Maskinfabrik AS has been the most successful manufacturer of tower cranes with hinged rigid-boom system with a load moment to 460 kNm. The small city cranes developed in 1961 as a crane brands Mangni S-40 (Fig. 8, a) with a carrying capacity of 2.2 tons at 18 meters radius and 1.6 tons at 25 meters radius. Payload was slightly increased in the model Magni S-46 of 1.25 meters with a start of 30 [4]. Short protyvahova console only 5.1 or 4.6 meters depending on the material or concrete counterweights with steel sheets. These improvements increased the versatility of the model tower crane. Today, both models can be found on construction sites of London and its surroundings. Near

the top of the traditional tower cranes Tornborg is light weight and can be installed on towers of various manufacturers such as BPR and Peiner.

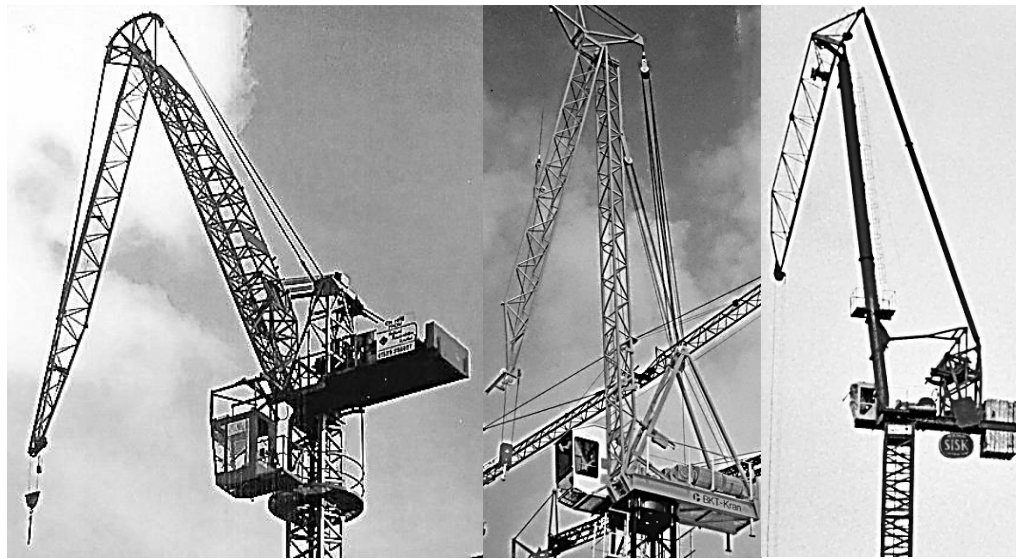


Fig. 8. Bashtovyi taps, hinge-jointed boom system, and - Tornborgs Mangni S-40; b - BKT BM 45; in - Krøll K103V.

Crane company BKT tried to review it Tornborgs hybrid cranes and in 1995 developed a model crane BM 45 (Fig. 8 b). Although this multi-crane can operate in two modes (both with hinge-jointed, and those with a lifting boom), but only a few cranes working on the construction. There is little demand for cranes with load moment of 400 kNm. The main advantage of a heavy crane of this design was horizontal movement of cargo by changing flight boom system, which was carried out by sophisticated control systems without relatively expensive mechanical solutions. Today this model is known in the market under the name MRC45-B3 in some manufacturer Potain.

In 1970 Krøll cranes designed K103V, K202V (Fig. 8) the outside like harbor cranes with hinged rigid-boom system installed on a conventional tower. The main advantage of these cranes was not only the possibility of movement of goods horizontally during flight changes, and the ability to work in a horizontal tower crane boom. In some cases, these valves are less sensitive to wind loads than cranes with a lifting boom system. The model range K103V protyvahovoyi console reaches 6.5 m, which is equal to the radius of turn composed jib system, so it can work in tight spaces.

The most modern of the crane with the construction of the joint-articulated boom system was developed in Switzerland under the name Cobra (Fig. 9). The first prototype was made in 2005. The heaviest model series C 638 Cobra departure raises the maximum load weight of

4.6 tons. The minimum radius of 2 meters. Equipped with a counterweight that using retaining ropes connected to the main section of the boom and the system moves on radial guides.

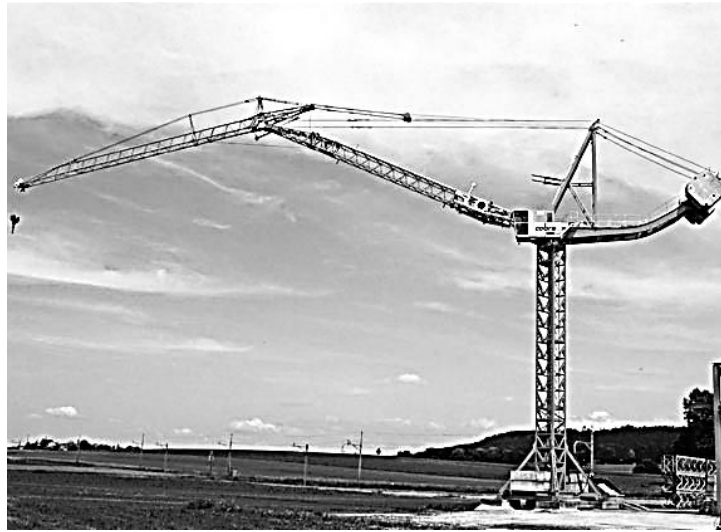


Fig. 9. Tower Crane 263S Cobra.

This change tap departure made only the movement of the boom system providing horizontal movement of cargo. Among the shortcomings hinge-articulated jib systems is the complexity of the design and mounting, high power over changes to departure and a large range of variation tipping point. The positive qualities is their flexibility, the use of a beam, with a horizontal movement of goods is ensured.



Fig. 10. Tower Crane SGME K100.

**Conclusion.** Construction boom systems play an important role in the operation of tower cranes. Depending on usage cranes equipped with lifting beam or hinge-jointed boom systems. Tower cranes with a lifting boom system used in confined construction sites where high maneuverability or on building construction where much of the work



cycle of lifting cargo holds, compared with a change departure. Tower cranes with a horizontal jib system easy to mount and operate, providing horizontal movement of cargo by changing departure and drives use less power. The main disadvantage beam jib systems is low flexibility, they are inconvenient to use in small, limited, construction sites. Tower cranes with hinged rigid-boom system emerged as a combination of lifting beam and jib systems. In such constructions cranes trying to provide both advantages and lifting jib systems and horizontal. Because cranes with hinged articulated-boom systems maneuverable and provide horizontal movement of goods, but the complexity of the design boom system increases the requirements for the mounting and operation of cranes.

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*Rassmotreny Constructions strelovyyh bashennyh of cranes. Conducted analysis of domestic and zarubezhnyh lyteraturnyyh of research on Constructions strelovyyh bashennyh of cranes. Examples Pryvedeny models with cranes bashennyh s image.*

***Strelovaya system vylet, Constructions, Tower crane.***

*The tower cranes jib designs has been considered. The analysis of foreign and domestic literary researches has been provided. Examples models of tower cranes with their images are shown in paper.*

***Jib, luffing, design, tower crane.***

UDC 631.35, 630.28, 620.95

### **PROSPECTS AND APPLICATION OF INERTIA-felling operations CUTTING shock when cleaning BIOMASS**

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LM Matiushenko, applicant \****

*The article presents the results of research line deflection theory stems of trees and shrubs species and energy benefits of bezstruzhkovoho cutting.*

***Power plants deflection stems shock cutting.***

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