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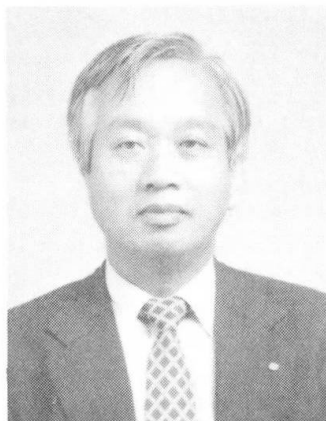
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## **Accident Prevention by Mechanization of Works**

Prévention des accidents par la mécanisation du travail

Unfallverhütung durch Mechanisierung der Arbeiten

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### **SUMMARY**

The safety of workers in construction is one of the most serious problems posed to those who are in charge of the management of any site of construction works. In order to realize the objective, the safety measures and facilities should be incorporated in the structure itself. It is important to analyze the causes of accidents, to find out where dangers for workers exist, and try systematically to keep workers out of hazardous places.

### **RESUME**

La sécurité des ouvriers est un des problèmes les plus importants posés au responsable de l'organisation de tout chantier de génie civil. Afin d'atteindre leurs buts, les mesures et systèmes de sécurité devraient être incorporés à la structure elle-même. Il est important d'étudier les causes des accidents, de localiser les dangers potentiels pour les ouvriers et d'éviter, de façon systématique, les emplacements dangereux pour les ouvriers.

### **ZUSAMMENFASSUNG**

Die Sicherheit der Bauarbeiter ist eines der bedeutendsten Probleme für alle diejenigen, die für die Bauausführung verantwortlich sind. Um das Ziel zu erreichen, sollten die Sicherheitsmassnahmen und -systeme bereits beim Entwurf des Tragwerks berücksichtigt werden. Es ist wichtig, die Unfallursachen zu analysieren, die für die Arbeiter bestehenden Unfallgefahren herauszufinden und die Arbeiter systematisch von gefährlichen Stellen fernzuhalten.



According to recent statistics of accidents occurred in the construction industry of Japan, the leading cause of fatal accidents was falls of workers from elevation, amounting to 37% of the total, and 6% of fatal accidents were caused by falling objects striking unfortunate workers. In total, 43% of fatal accidents during construction period took place because the labourers were positioned in such dangerous places that if some unanticipated happenings occurred they would entail accidents to death to the labourers. In other words, if we succeed in keeping the workers out of dangerous places we will be able to eliminate almost half of fatal accidents encountered nowadays in the construction business.

Those who are concerned in the construction of structures at the sites are all aware of the importance of this fact. They are always trying their best in providing necessary facilities to secure safe and stable footstands for workers, making arrangement of construction procedure in a way that workers are always assured to be safe and training the workers to be careful in avoiding any hazardous place.

But this is not enough as the number of accidents shows. Construction sites of structures are usually so narrow and construction periods are so limited that labourers are obliged to work in hazardous situations such as under where other labourers are hauling a heavy structural member. These conditions are beyond the reach of field engineers. In order to solve the problem effectively, it is necessary to have the cooperation of planners and designers of the project. These engineers are primarily preoccupied by the economical and safety aspects of structure itself. They are sometimes short of experience in erection works of structures, or they do not have enough time to pay their attention to the safety of workers who put their projects to the realization. But there are a lot of things to be taken into consideration at the early stage of the project planning affecting the occurrence of accidents in the later stage of the project realization. For example, preparation of large space in the structure in the design will allow easy handling of structure members in it at the erection stage, or attachment of provisional supports for safety ropes in the fabrication will assure the safe movement of workers at the construction stage.

The concept of safety should be kept in mind not only by the engineers on the construction fields but also by the planners and designers of structure. The target of no fatal accident will be achieved by systematical incorporation of all safety measures into the design of structure and the implementation schedule of the project.

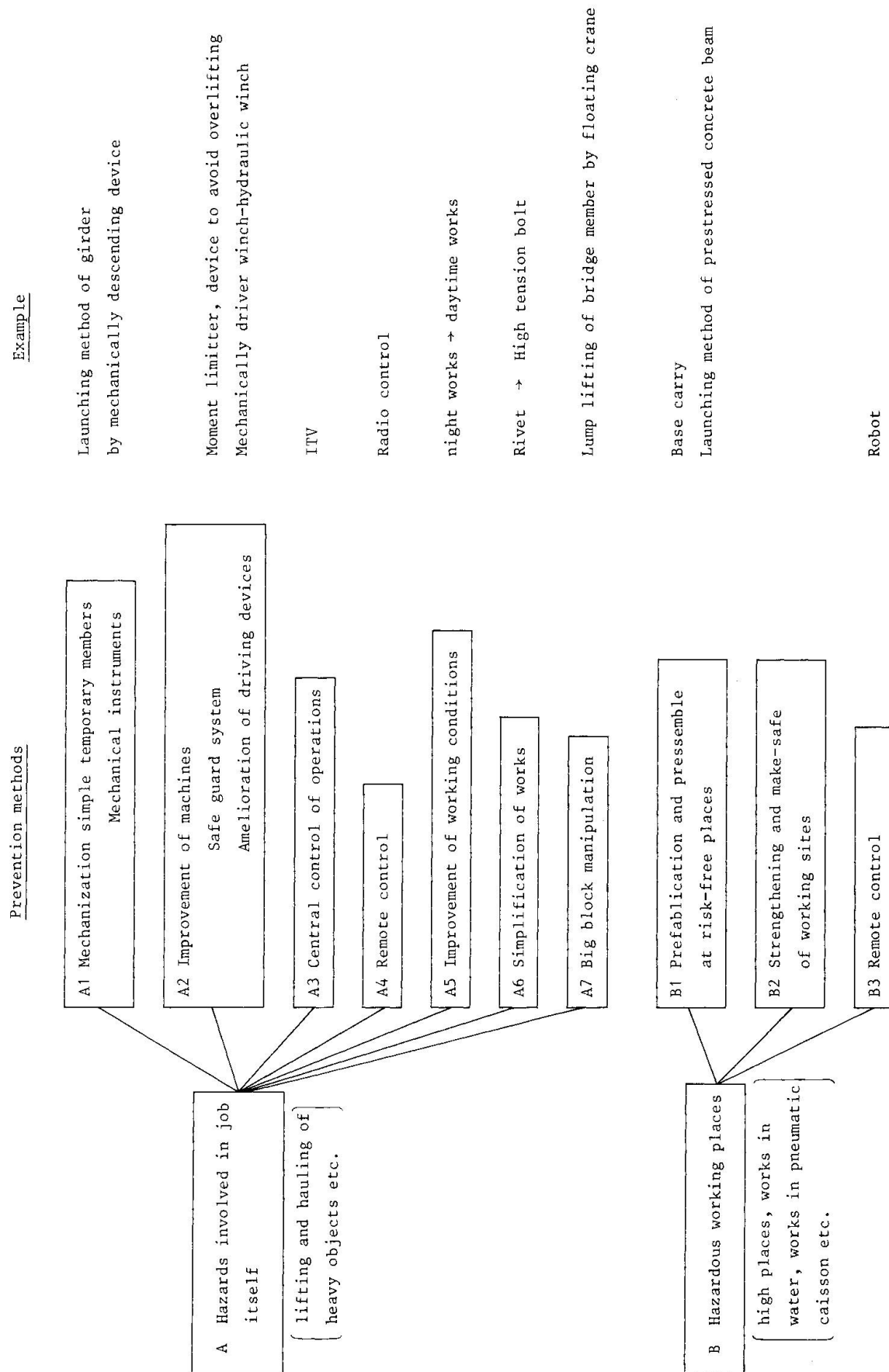
For this purpose, the causes of accidents should be clearly analyzed to enable all engineers concerned to find out where hazards are and to eliminate them. The Table 1 shows kinds of hazards and the ways to eliminate them.

The most direct way to bring the workers out of danger is the replacement of workers by machines equipped with remote control devices.

On several construction site of pneumatic caissons, digging of ground was carried out by excavation machines which were manipulated from outside of the caisson, and the process of excavation was observed again from outside by the use of industrial televisions. In a consequence there was no worker in descending caissons which were full of hazards before.

Similarly radio control bulldozers designed for the operation in the water relieved drivers of unforeseen dangers in rivers.

Table 1 Hazards and their control



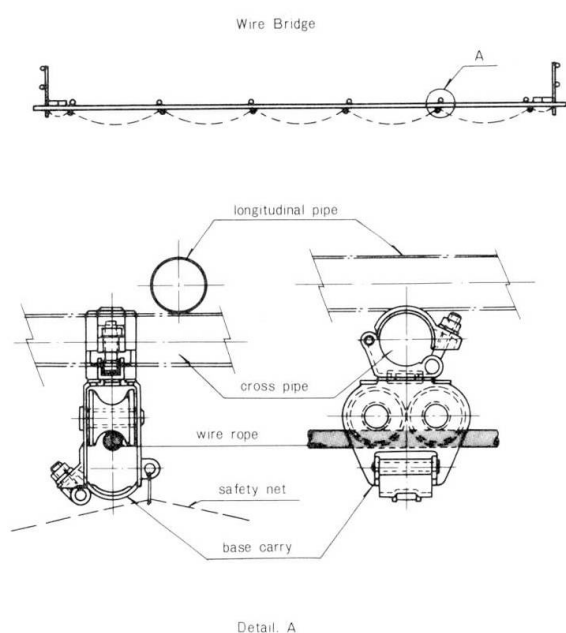
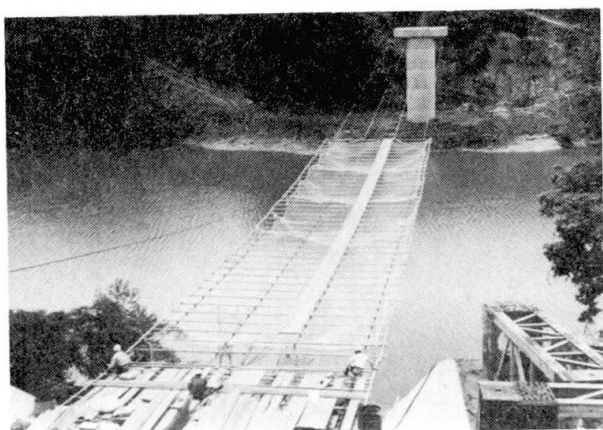


Fig. 1 Wire Bridge and Base Carry



Picture 1 Base Carry

The next step is the prefabrication of members or erection facilities outside of hazardous places. The setting up of safety net was quite a dangerous operation which bridge builders were obliged to overcome at the first stage of construction. This problem was solved by means of the safety net preassembled nearby places free from danger and then pulled out by guidance cables. (Fig. 1 and Picture 1)

Launching method of erection for prestressed concrete beams is widely used for the same purpose.

The simplification of fabrication and erection of structures is also of great importance in this respect. The lifting up of a long girder portion to its final position by use of floating cranes with big capacity is much easier and safer than long sequence of connection works of the small members for the same structure.

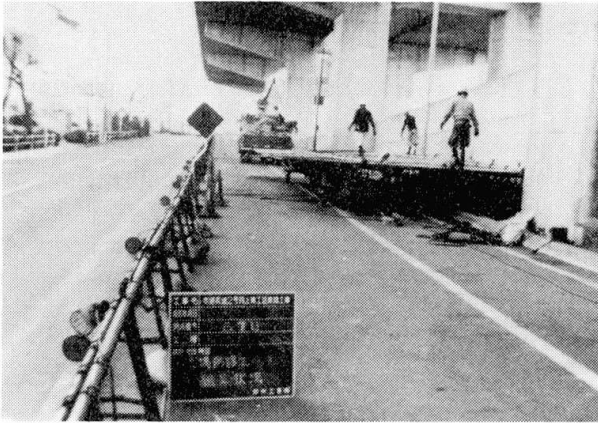
Another aspect of hazard control is based on the fact that construction works will be carried out more safely in daytime than at night.

Coupled with the necessity of elimination of noise at night, one of principal public nuisances, the contractors who work for the construction of urban expressways in densely populated areas are forced to implement the major portion of their works in daytime in spite of heavy traffic circulating on the streets under the expressway projects.

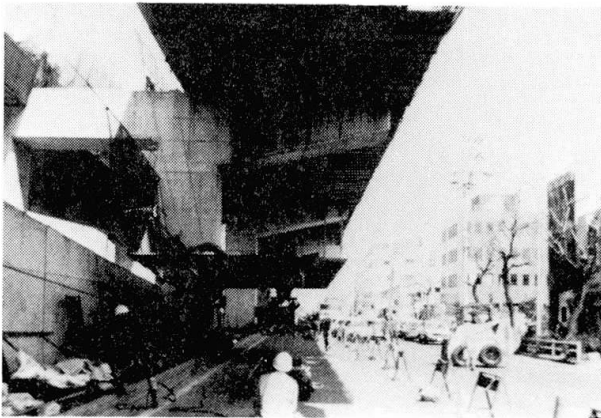
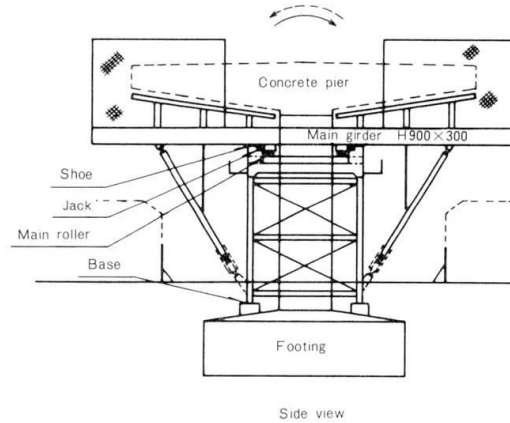
Nagoya Urban Expressway Corporation is trying hard to solve this problem through various means and ways. Picture 2 and Picture 3 (with details illustrated in Fig. 2) show respectively a scaffolding and a beam to be

used as a support of steel formworks for a cross beam of a pier. These temporary works are assembled within the narrow fabrication area obtained along the streets, then turned around and lifted or simply turned around to their final position during short traffic intervals while the traffic on the streets is stopped at the nearby street crossings. The construction of the permanent structures can be carried out continuously on these temporary works.

An erection system of a three span continuous girder for the expressway over a street was thought out. In this case, in order to avoid erection works over the street, the girder is assembled parallel to its final position over the fabrication space prepared in the center portion of the street where bent supports are allowed to be used temporarily. Then the girder is pushed horizontally to the



Assembling work



Lifting work

Picture 2. Scaffolding being lifted without any disturbance to the street traffic under the construction site

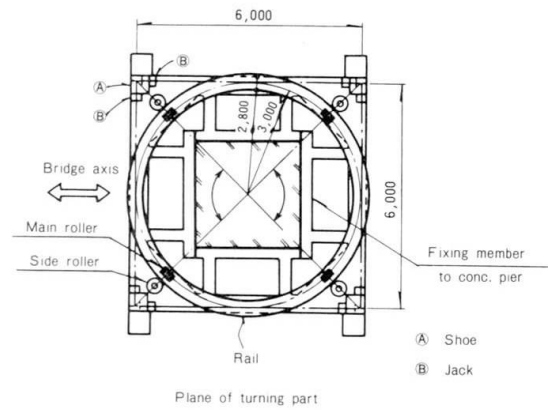
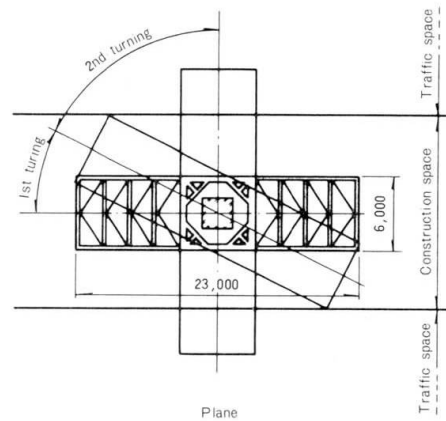


Fig. 2. Device to make construction beam without any traffic disturbance



Picture 3. Construction beam for cross beam without any traffic disturbance



planned position by 4 oil jacks controlled and operated simultaneously. The horizontal hauling of the girder is allowed only while the traffic on the street is stopped by traffic signal of nearby street crossing, the operation as a result does not cause any disturbance to the traffic even when the traffic under the construction site is heavy.

In conclusion, the mechanization of construction is very effective for the increase of the safety of works. However, according to the above mentioned statistics, 30% of total accidents to death of workers in construction were caused by defects of equipment or malmanipulation of machines. It is necessary therefore to plan the project, to design the structure and to carry out the works for the proper and adequate use of machines in order to save the lives of workers.