

**Concrete mould timber support collapse accident in the gymnasium construction work  
in Maritime Self-Defense Force Atsugi air base.**

**[February 14th, 1992 (Fri). The Kanagawa Prefect. Ayase City.]**

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During the concrete installation work of the beam and the slab of the second floor of the gymnasium, installed concrete and slab's reinforcing steel fell and 7 people died, and 14 people got injured.

**1 Event**

During the concrete installation of the second floor, a built truss which supported the mould for the slab fell.

After about 25 minutes, a chain reaction collapse of the moulds and the mould timber supports spread from this falling point, and 2/3rds of concrete and reinforcing slabs of the second floor fell down. And the workers who were working on the inspection at the 2nd and the 1st floor were pinned under these fallen materials, and 7 died, and 14 got injured.



Fig-1. Situation of the whole (Source: the Ministry of Labor survey report)

**2 Course**

By the previous day of the accident, concrete was placed in the first floor column and the external wall under the girder mould. And during concrete installation of the slab on the day of the accident, a beamed member of the built truss with coffer forms ( the mould boards ) on its both sides with placed concrete in it fell on the shelf scaffold just below that ( figure 2 references ). The installation work was immediately stopped, and some persons descended to the first floor to grasp the situation. There is a testimony that the inflow of the concrete was resumed after a while at another section of the second floor.

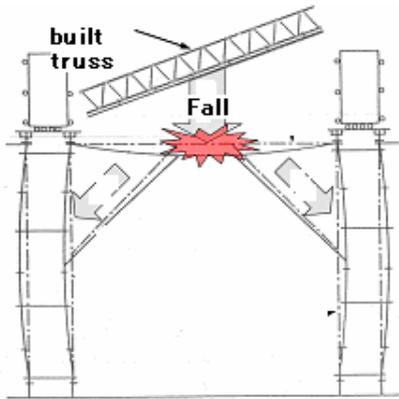


Fig-2. The bend of the pillar by the built truss falling (Source: the Ministry of Labor report)

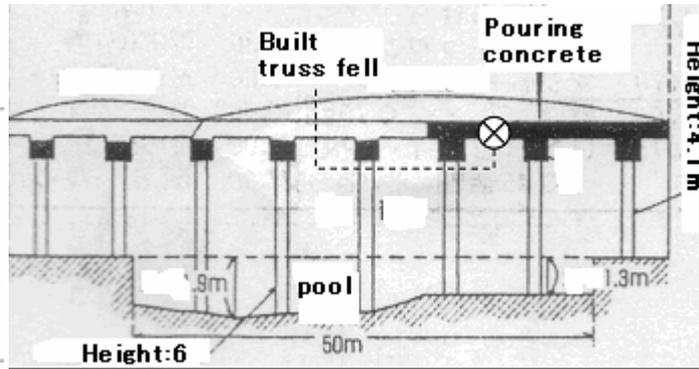


Fig-3. Outline drawing of the timber support collapse (Source: Asahi Shim bun article).

After about 25 minutes, a collapse of the mould timber supports began from the part of this built truss, and it spread rapidly, and it lead to the whole collapse (figure 3 references).

### 3 Cause.

- The direct cause.

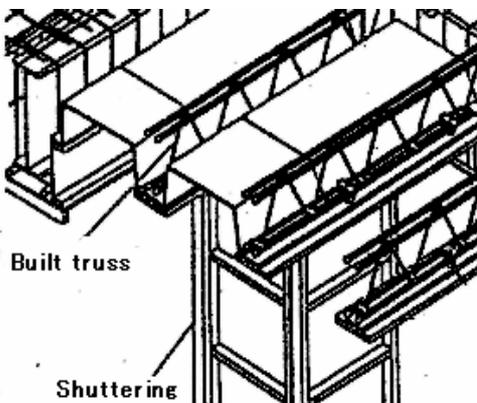


Fig-4. The built slab method (Source: the Ministry of Labor report)

In this construction, the built slab method was applied. A feature of this method is to omit the process by prefabricating the moulds. The members used in the mould are the built trusses. The built trusses are the truss reinforcing steels of about 6m in length, and they become finally a part of the floor, but in the concrete construction, they also play a role as supports of the mould boards from the inside. Therefore, the traditional timber supports from the outside are unnecessary.

In the investigation of the part which didn't collapse, results which show support blocks of the built trusses were not established right under the loading point and results which show there were the gaps between the support blocks and centers of the built

trusses were found, and the support blocks can break or buckle in such cases. The similar assembly seemed to have been carried out in the accident scene. As the result, the falling of the built truss which became the origin of the accident occurred.

The mechanisms of the whole collapse are as follows. The scaffolds (the shelf scaffolds) of the workers were installed in the way that braces were fixed on the pillar, and the stage planks were installed on them horizontally. When the built truss and concrete fell on the shelf scaffold, the impact transmitted through the braces to the pillar, and the load in an oblique direction affected it, then the pillar reached the proof stress, and it bent as figure 2. The structure of the mould timber support and the scaffold should have been independent from each other in order to ensure strength, but on this site, the scaffolds had been installed on the pillars through braces, and moreover, since they were fixed near the joint (the link part) which is a structural weak point of the pillar, the strength of the pillar has been considerably lowered. Therefore, the pillar finally lost the retention capacity force and collapsed, and this developed into a chain reaction, and it led to the collapse of the whole mould timber support.

- The indirect cause.

The contractor carried out this construction and the plan and management of it, but the design of the gymnasium had been done by the owner. In the design by the owner in the beginning, the traditional mould method had been adopted. And it was changed for the built slab method about 4 months before the accident, following an offer from the contractor that it wanted to save the labor because of the labor shortage (figure 5 references). Then, the specification which was attached to the petition for change was adopted, and the construction became based on the specification written by the contractor.

The built slab method was developed by Chuo Build Industry Co., Ltd, and after the recognition of Minister of Construction was received in 1979, it was adopted in about 300 cases by the time of the accident day, and it can be said that it was the comparatively new technology. In fact, it was only the field director who had experience of this method from all the staff at that time, and the mould timber support operation chief was completely inexperienced. In addition, it is said that the mould timber support operation chief didn't even receive the changed drawing. The anxiety about the safety of this method spread among the subcontractors, and it seems that the whole staff was embarrassed by the inexperienced method.

And there is a background that, the contractor was not decided even after 4 rounds of selective competitive bidding since the target price estimated by the owner was too low,

and the price which the contractor received by optional contract was about 60 million yen lower than the bidding price. So the design change for cost saving might have been done without considering the risks.

#### **4 Immediate Action**

In the first disaster in which a built truss fell, the concrete inflow work was stopped, and the field director and some workers went to confirm the situation, consider the countermeasures and conduct treatment the fallen concrete on the first floor. And the secondary disaster occurred afterwards.

After the accident, Kondo Minister of Labor inspected the field, and directed investigation. The remedial work began in April, and the Ministry of Labor established the special technology survey team and undertook the investigation of the disaster cause.

#### **5 Countermeasure**

In the accident investigation report by the Ministry of Labor, the cautionary note in the construction, and the necessity of ensuring safety of mould timber supports by information collection during the innovative technique introduction, etc. are described.

From April of the same year, the construction cost integration standard in public works was revised for the improvement in the technical capacities of field workers, and safe training for the workers in the field more than once a month for half a day was imposed, and the cost for that was newly appropriated.

In "the secondary structural improvement promotion program" of the construction industry decided in the same year, improvement of work conditions and security and fosterage of the personnel were stated as the plan to be carried out.

#### **6 Generalization**

This construction gives the strong impression that the contractor hurried up the construction very much. One of the causes was the serious manpower shortage. The manpower became insufficient, while the construction technology advanced, and the possibility of the major accident by the expansion of divergence between technology and proficiency was indicated, and it raised the social problem of labor shortage in the construction industry.

#### **7 Knowledge**

The safety is first. ... Stop at the red signal even in a hurry. Escape when the floor

falls even if you want to execute construction.

Do ordinary work properly ...It is unexpectedly difficult to adequately do work which is easy even for amateurs.

Direct your eye to what supports us. ...Never treat the pillar carelessly which supports all.

When facing something new, have both of anxiety and expectation. ...Be careful because there is a risk, even if the construction period can be shortened.

## **8 Sequel**

The field director had the fault of neglecting the duty to evacuate the workers, but charges were dropped because of his death. The other construction parties' indictments were suspended the indictments for the reason of concluding the private settlement with the bereaved families.

## **9 On the Side**

1992 was the year of the bubble economy collapse. The people were still obsessed about the bubble economy. At that time, the manpower of Japan consisted mainly of white-collars, and the construction industry was shunned as "3K" (dirty, severe and danger) and suffered a serious labor shortage. Especially, the shortage of the skilled workers such as reinforcing-bar placers and mould engineers, etc. peaked in 1990 and 91, and this accident occurred just at that period. Afterwards, the construction labor shortage rate has descended as well as stock prices and land prices, and returned to zero.

<Reference>

The investigation result report of the concrete mould timber support collapse disaster in the gymnasium construction work in Maritime Self-Defense Force Atsugi air base (Ministry of Labor 1993)

The construction accident (Nikkei construction 2000)

The House of Representatives conference minutes, the 123rd Diet, Labor Relations Commission, No.1.

(<http://kokkai.ndl.go.jp/SENTAKU/syugiin/123/0340/12302260340001c.html>)

The House of Representatives conference minutes, the 123rd Diet, Labor Relations Commission, No.4.

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Chuo Build Industry Co., Ltd (<http://www.chuo-build.co.jp/sub4461.html>)

**Construction labor supply and demand survey result**

**(<http://www.mlit.go.jp/toukeijouhou/chojou/rodo.htm>)**

**Second structure improvement promotion program.**

**(<http://www.mlit.go.jp/sogoseisaku/const/kengyo/kouzoukaizen1992.pdf>)**

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