

## Construction Cases and Development Courses of Blasting Demolition Method

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### 발파해체공법의 시공사례와 발전방향 데이비드 세티완 누글로호, 파라비타 서리 올렌다, 안명석<sup>1)</sup>

#### I. Introduction

Blasting demolition method for a structure or building was developed and carried out by CDI (Controlled Demolition International) Co. Ltd. of USA in 1947. It was a high technology and had been using for 40 to 50 years for the economic demolition of concrete structure and reducing environmental pollution in USA, England, Germany & Sweden.

All preparation work of the construction are accomplished in demolishing the structure and offered a good economic effect of the construction period reduction (curtailment). Demolition method has the satisfactory construction safety management, moreover it minimizes environmental pollution factor of noise, scatter, and dust.

Blasting demolition method for a building is a method of putting a small powder in a main spot such as a column or wall and then removing the spot with a blasting, dissolving the structure stiffness, and weakening the structure stability.

#### II. Main Subjects

##### 1. Types of blasting demolition

###### A. Felling (see Fig. 1)

- Overturning collapse with a predetermined direction and a sufficient space is needed.
- The simplest method.
- It is usually used for chimney, water tank, transmission tower (or electricity).

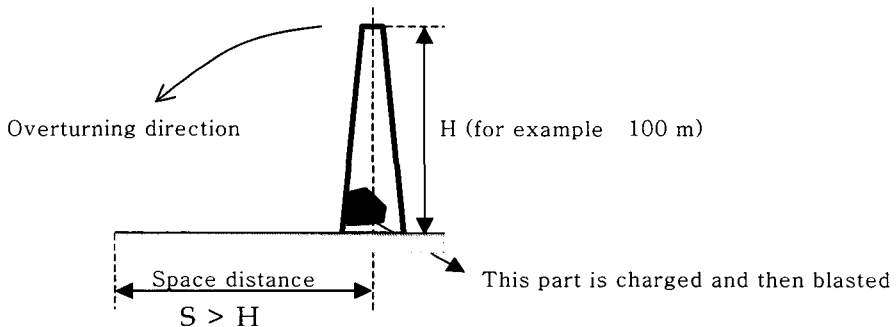


Fig. 1. Blasting demolition felling type

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B. Toppling (see Fig. 2)

- Breaking down one side of the building with a column of 2 to 3 rows.
- Collapse and overturning occur together.
- Applicable for one or two collapsing direction of high rise building.

C. Telescoping (see Fig. 3)

- Collapsing happens at the original place of the building.
- Applicable when there is so much space available ( $S_1$  and  $S_2$  in figure 3 show when there are not enough spaces).
- Continually collapsing started from the first blasting row.

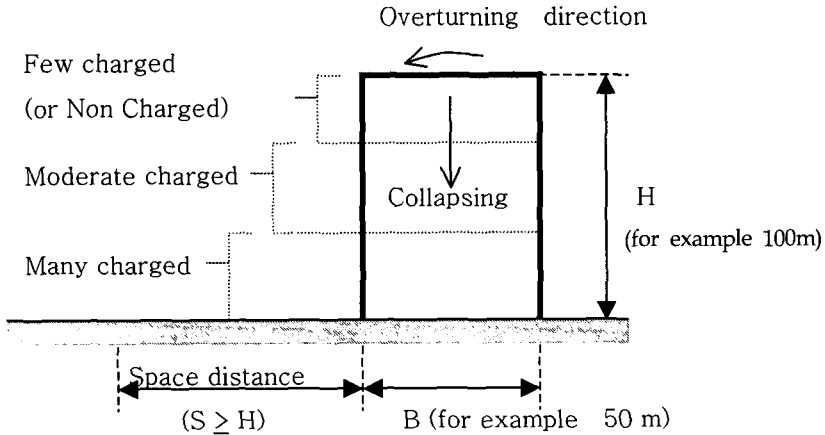


Fig. 2. Blasting demolition toppling type

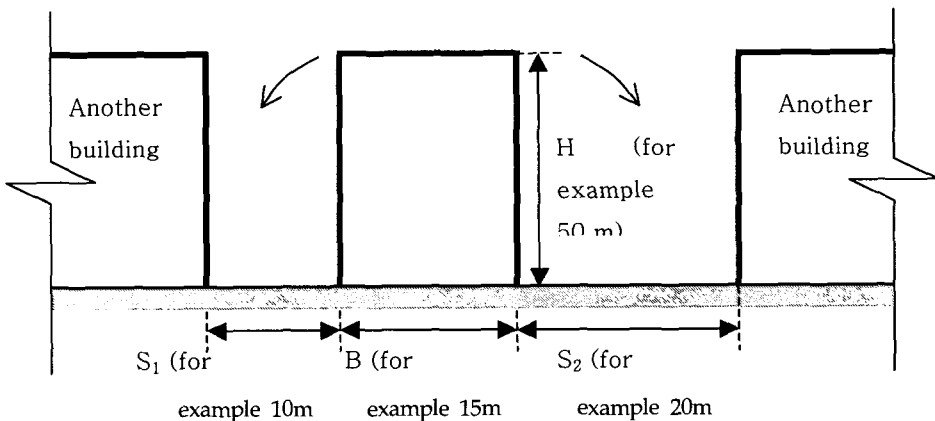


Fig. 3. Blasting demolition telescoping type

D. Progressive collapse (see Fig. 4)

- Approaching the implosion technically.
- Linearly collapsing.
- Applicable for such a long structure like apartment.

E. Other methods: implosion and sequenced racking

2. Main Processes

A. Drilling (see Fig. 5)

- Drilling is made in the main objects or spots for blasting demolition such as columns or walls.
- Drilling holes must incline downwards to improve the efficiency of charging.

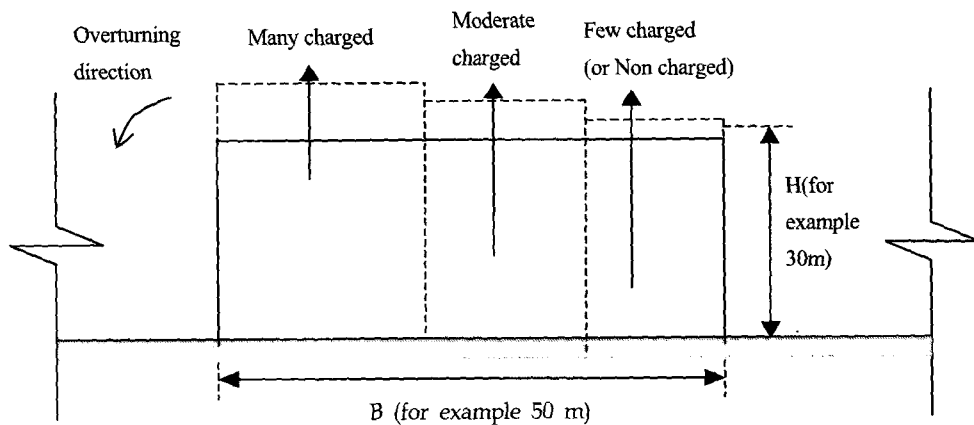


Fig. 4. Blasting demolition progressive collapse type

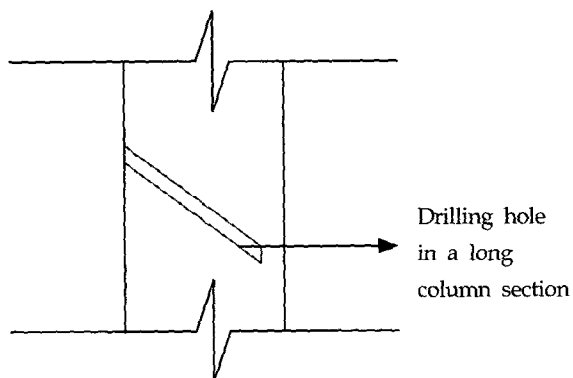


Fig. 5. Downwards drilling hole in a column

B. Charging and stemming (see Fig. 6)

- Normally there are 4 free faces in case of a concrete structure and because of a short burden, the density of the load is high and used of explosives such as HiMITE, NEWMite with good fragmentation. Gelatin dynamite with detonation velocity of 5500 to 6500 m/s is used as explosive and diameter of 25 to 32 mm.
- Detonator: electric detonator MSD of LP; detonating cord: PETN 5 to 10 gram/m.

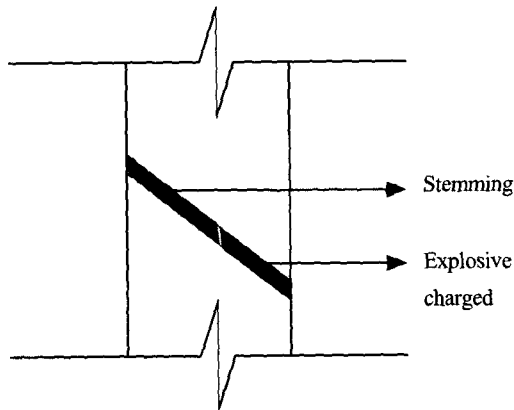


Fig. 6. Charging and stemming

C. Protecting

- In case of a concrete structure, it controls the concrete fragment and dust caused by air blast or spouting gas.
- Direct protection action for the main objects, it uses material protection on the outer side of the object.
- Indirect protection action by giving no-charged part of powder to control fragmentation and dust that is to escape and scatter out.

- The demolishing time is about 5 to 15 seconds, so it may reduces inhabitant's inconvenience.

D. Blasting

- In case of a concrete structure, because its sectional stability is very weak, so small stress is enough for demolishing in a short period.
- In case of steel structure, the use of shaped charge is common for a steel tower and truss.

3. Records of blasting demolition

In Korea some building demolishing by blasting demolition has been done for several years in the past (1991 to 2001). They were equipped by some types of blasting demolition mentioned in this paper (felling, toppling, telescoping, progressive collapse, implosion, and sequenced racking).

A combined method (two or more than two methods) was done also like in 1993 for Sokcho Kingdeom Hotel by implosion and toppling; 1994 by telescoping and progressive collapse for Life building and Mt, Nam foreigner apartment.

#### 4. Reviewing the techniques of blasting demolition

##### A. Evaluation for Near-Miss blasting

- Social-environmental view of point

Problem : the latest vague expectation and abroad technology did not become a big help in actual action.

Improvement : measuring the domestic technology prior to indiscreet aboard technology; active interest, effort, and participation more than connection specialist are required.

Problem : no official recognition, examination, lacking of confirmation of the product, difficult security, and kick-back phenomenon was occurred.

Improvement : authorities of explosive product, organization to check structural calculation and design, skilled artificer + engineer, and government support + industry, research institutions are needed.

- Technical view of point

Problem : engineering, mechanical, material, blasting demolition analyses were lacking and the engineering theory was unprepared.

Improvement : structural analysis method, model simulation, and technique researches are urgently required.

Problem : so much dust scattered, inconveniencing the neighborhood, noise pollution, and flying stones.

Improvement : completely and perfect work of indirect protection such as drilling, charging, and stemming before installing the material protection (direct protection).

Problem : noise pollution caused by detonated cord used.

Improvement : developing a special procurements explosive that does augmentation

to steel frame structure and cutting + noise decreasing ability in pressing.

Problem : horizontal migration structural calculation was omitted; kick-back phenomenon was failed in blasting to take into pieces.

Improvement : reserve crush is needed more than prudent attention to the structure accuracy of mechanical calculation and weakness.

Problem : the lateness of counting down, so the two buildings were not collapsed more than charged state suddenly.

Improvement : harmonizing the counting down and confirming the blasting capacity. Before blasting, the charge state must be checked. This emergency principle parts needs full knowledge and training.

- Pollution-environmental view of point

Problem: due to environmental matter, hazardous substance, permission of waste administration was complicated and there was difficulty in popular enmity solution.

Improvement : reorganizing the environmental legislation to explosive control permission. It needs ethnography degree by professional institution sincerity.

Problem : expenses affected the unit price of the big building blasting and dropped construction economic performance in settlement of concrete waster that occurred in the site.

Improvement : considering concrete and waste recycling for reinforcing bar, providing research for exhausted place and policy support.

##### B. Evaluation for WTC Building Collapsing

WTC building consisted of 6 underground floors, 110 ground floors, and pillar center space of 100 cm. This building was designed with a horizontal connection between these twin

building (pin structure).

When the collision happened, the north tower collapsed after 1 hour and 43 minutes by direct hit to the 80th floor at 8:45 am. Afterwards, the 52nd floor of the north tower was hit at 9:30 am and collapsed after 1 hour and 2 minutes.

Steel frame was melting caused by airplane fuel temperature increasing (1100 to 2000). When collision occurred, the cosmic ray energy content was 278 Mwh (1% of atom bomb energy). Because of very high temperature in the frame, the columns were collapsed.

#### 5. Developments of blasting demolition

- It needs efficiency of business and autonomy security with full equipment related to the laws, regulations, and administration to simplify the permission matter.
- Because of research and development of simulation techniques collapsing mechanism is also important.
- Shaped charge development and scattering dust prevention is taken into research for steel frame structure.
- The use of conventional type of blasting depends on price competition, later on the waste processing expense reduction research for a small scale construction.
- Upgrading the technology, professional artificer, and engineer security way research for safety accident prevention.
- Construction accident insurance drafting, expert skill person's safety, economic performance review, full text supervision system development.
- Systematic device preparation for Near-Miss blasting example, collection and analysis take place during construction and know how to store the accumulation.

### III. Conclusions

#### 1. Advantages of blasting demolition

- Lower cost.
- Saving time.
- Enough safety.
- Reducing the noise and gas.

#### 2. Applications of blasting demolition

##### A. Reinforced concrete structures

- High stories apartment.
- Office building.
- Bridge pier.
- Special structures.
- Stack.
- Silo.

##### B. Steel structures

- Truss bridge.
- Power transmission tower.
- Electric wave tower.
- Manufacture plant.

#### Review and Global Evaluations of Blasting Demolition Method

1. It is necessary to apply failure instance (kick-back phenomenon) and WTC airplane collision collapse (bending and left refraction phenomenon) as example of silo blasting method of construction.

2. Blasting engineering and simulation is needed for developing the professionalism.

3. Systematic device preparation for Near-Miss blasting example and we know how to store the accumulation.

4. Public information to prevent vague uneasiness of the society about demolishing a building.

5. Reciprocity effort for the insurance during construction.