# SAMPOONG COLLAPSE

## *A Tragic Man-made Disaster*

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## 1. Outline of the Accident

*(1). Name of the building: Sampoong Department Store*

*(2). Date and time : 5:50 PM, June 29, 1995*

*~ sudden fall-down from top floor to bottom of basement*

*(3). Casualties: 501 killed, 937 injured*

*(4). Structure: RC structure flat slab system w/ drop panels*

*(5). Stories: 5 FL above and 4 FL below G.L.*

*(6). Floor Area: Total 73,877 $m^2$*

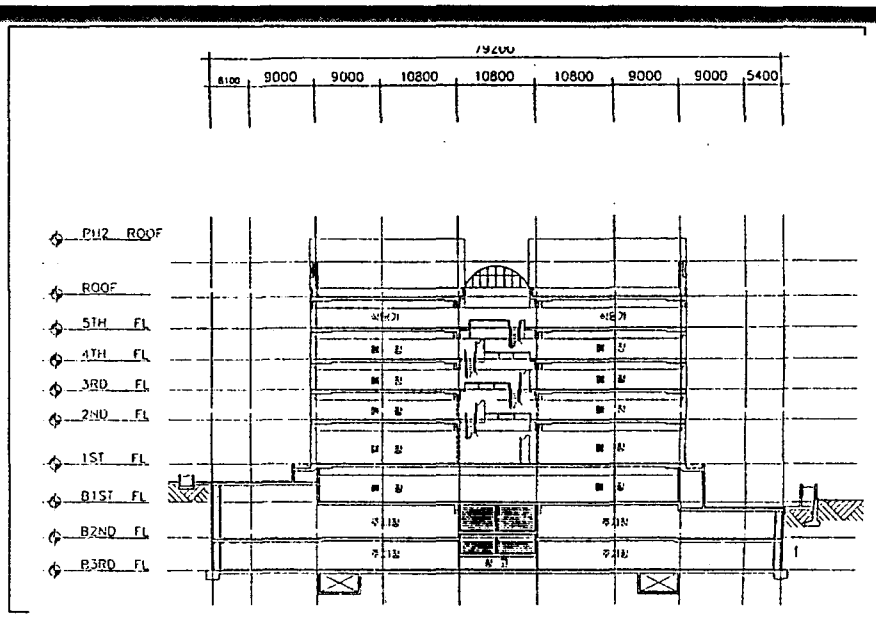
*(7). Construction Period : Sept. 1987 ~ Dec. 1989*

*(8). Building Age : 5.5 years*

## Section of Building

| | | |
|---|---|---|
| Glass roof to concrete slab | R | Roof Garden - cooling towers moved |
| Expansion of 5th floor | 5F | Food Court - modified roller skate link |
| | 4F | Home Appliances |
| Escalators installed | 3F | Men's Clothes |
| Escalators installed | 2F | Lady's Clothes |
| Escalators installed | 1F | Miscellaneous |
| Expansion work of 660m$^2$ | B1 | Fast Food - five pillars eliminated |
| Expansion of parking lot | B2 | Parking |
| | B3 | Parking |
| | B4 | Machine Room |

## Cross Section of the Building



## 2. Causes of the Accident

*(1). Design and Engineering*

- *neglected thorough analysis of structure calculations.*
- *did not follow the design code and procedures.*

*(2). Construction and Supervision*

- *irregular practice by the construction company.*
- *loose supervision of the construction.*

*(3). Maintenance*

- *frequent modification.*
- *illegal expansion of sales floor.*

## 3. Detailed Analysis of the Causes

*(1). Less span than design*

| Design: three span or more | Actual: two span only |
|---|---|

*(2). Longer span than design*

| Adequate: 7.5mx7.5m or less | Actual: 10.8mx10.8m |
|---|---|

*(for a better space view, less number of columns were used)*

*(3). Overloads of roof*

| Design: 100 kg/m2 | Actual: 210 kg/m2 |
|---|---|

*(4). Relocated cooling tower (400 tons)*

| Design: rear | Actual: front |
|---|---|

*(5). Column reinforcement*

| Design: $\phi$ =800 m/m w/bars D22-16EA | Actual: $\phi$ =600 m/m w/bars D22-8EA |
|---|---|

## *Detailed Analysis of the Causes (continued)*

*(6). Management by shoddy sub-contractor*

*(7). Failure of quality control*

*(8). Absence of proper management*

*(9). Frequent modification & illegal expansion*

*(10). Impact of crumbling top floor*

*(11). Failure of punching shear at columns*

## *Detailed Analysis of the Cause (continued)*

*In summary,*

- *all engineers were lacking professionalism*
- *worked haphazardly and carelessly out of bad habits (so called "It's all right, Quickly Syndrome").*

☛ *With the painful lessons from "Sampoong" accident still vivid in our minds, each one of us changes our mind to achieve the Mercedes Benz-like quality in building construction.*

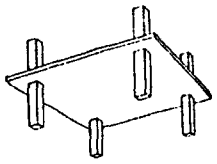
## *Building Code For Flat Slab Design: Methods of Analysis*

1. *Recognized Elastic Analysis*
2. *Empirical Method*
   - *Limitations for use of flat slab*
     - *Span layout*
       - *L/B = not more than 1.33*
       - *slab continuous over 3 or more panels in each direction*
     - *Thickness of Slabs*
     - *Shear*
     - *Reinforcement*
     - *Openings in flat slab*

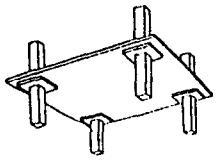
## *4. Characteristics of the Building Structure*

***Reinforced concrete structure with drop panels***

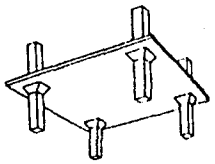
***flat plate slab***



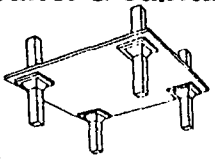
***flat plate slab w/drop panel***



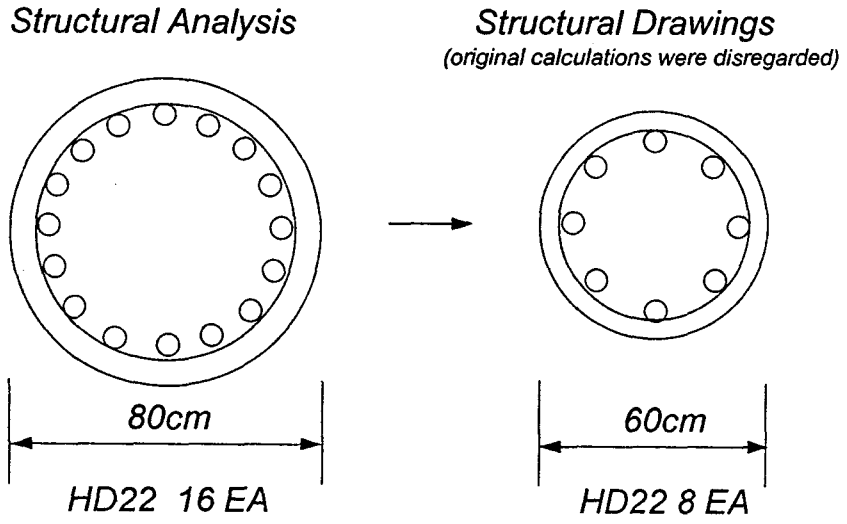
***flat pate slab w/capital***



***flat slab w/drop panel & capital***



## Difference Between Drawings & Calculations




## 5. Remedial Measures after the Accident

*(1). Government actions are :*

- *regular safety-check.*
- *tight supervision at every construction stage.*
- *harsher punishments to shoddy construction.*

*(2). Government safety advisory established for :*

- *safety measures for construction related disasters.*
- *codes and regulations for construction safety.*
- *approval of qualified safety Investigation firms.*

*(3). Opening supervision and management market to foreign firms and third parties.*

## 6. Example of Remedial Measures Abroad

*(1). Japan (Apr. 8, 1970)*

- *Gas explosion in subway construction site, Osaka*
- *79 killed*
- *strict safety procedures enforced afterwards*

*(2). USA (July 17,1981)*

- *Collapse of swinging bridge at Hyatt Regency Hotel, Kansas City, Missouri*
- *114 killed, 200 injured*
- *mandatory safety bond required afterwards*

*(3). France (Jan. 26, 1994)*

- *Collapse of casino roof slab in supermarket, Nice*
- *3 killed, 97 injured*
- *qualified workmanship enforced*