

# Ultimate Strength of Carbon Fiber Chip Reinforced Concrete Cylindrical Shells with Openings under Impact Line Load

by

<sup>\*1</sup>Kazuhiko MASHITA, <sup>\*2</sup>Kazuomi MINAMOTO, <sup>\*3</sup>Yoshinori SATO,

<sup>\*3</sup>Takashi KUMADA, <sup>\*3</sup>Yuko SUZUKI

(Received on Aug. 20, 2001, accepted on Nov. 21, 2001)

## Abstract

The main purpose of this paper is to investigate both experimentally and theoretically, the strength of carbon fiber chip reinforced concrete circular cylindrical shells with openings under impact line load.

Recently in our highly developed and complicated society, it is favorable that not only standard static load but also impact load for shell and spatial structures might be taken into account as the design load, because these shell structures could provide for large capacity of audience and sometimes refuge shelter from a natural disaster.

Although the features on carbon fiber chip reinforced concrete shell could show the highly isotropy and homogeneity in mechanical behavior and smooth adaptability to curved surfaces in construction, the strength on a shell with edge beams and openings under impact load could be hardly estimated.

In this paper the effect of edge members and openings on shell strength under impact line load was investigated. The experimental study was conducted on small-scaled carbon fiber chip reinforced and standard steel reinforced concrete shell specimens. The theoretical study was conducted using the nonlinear transient dynamic finite element analysis. The strength and failure patterns of a shell with edge beams and openings under impact line load were discussed based on the results of the experiments and numerical analysis.

**Keywords:** Concrete Shell, Carbon Fiber Chip, Impact Line Load

---

\*1 Professor, Department of Architecture and Building Engineering.

\*2 Taisei Corporation.

\*3 Graduate Student, Course of Architecture and Building Engineering.