



Technical Bulletin No. 4

IPANEX Concrete Topping Over Double T-Beams Exhibits Outstanding Performance on Philadelphia International Airport Parking Structures

HISTORICAL DATA

The Philadelphia Parking Authority opened two new five story parking structures at the Philadelphia International Airport in 1976. These facilities known as garages C and D accommodate approximately two thousand cars each with a total parking area of 1,100,000 square feet. The structures were designed and built with precast concrete columns, beams, and double tees over which a cast in place topping of IPANEX concrete was placed. An average of 250,000 cars per month utilize the parking spaces within the garages.

INDEPENDENT STUDY

The firm of A & R ENGINEERING CO., INC., of Philadelphia, Pennsylvania was requested by IPA SYSTEMS, INC., in August 1991, to report on the performance of the IPANEX concrete deck topping. In September of 1991, a "Report on Concrete Deck Topping, Philadelphia International Airport, Garages C and D" was issued.

BACKGROUND INFORMATION

The following background information is contained in the report:

C & D Garages

5 levels each

Capacity - 2,000 cars each

Total topping area-1,100,000 square feet

Design: Precast concrete columns, beams and double tees with cast in place topping

Woven wire fabric #66-44 for crack control

Standard reinforcing bars over beams and along spandrels

All electrical conduit and boxes were embedded in the IPANEX concrete topping

Clearance from top of concrete to mesh or bars $\frac{3}{4}$ "

Minimum thickness of topping $3\frac{1}{2}$ "

Compressive strength of concrete topping 4,000 psi

Air entrainment $5\% \pm 1$

IPANEX 1% by weight of cement

USING CURRENT TECHNOLOGY

The following changes to the 1974 specifications would be made to increase concrete durability and corrosion resistance:

Reinforcing bars and mesh would be galvanized or epoxy coated.

Electrical conduit and boxes would not be embedded in the topping.

2" minimum concrete cover over reinforcing steel and mesh would be required.

VISUAL SURVEY

In September 1991, A & R ENGINEERING CO., INC., surveyed the garage decks to determine the extent of various types of deterioration to the concrete topping. The survey indicated that distress in 1,100,000 sq. ft. of decks was limited to:

<u>Area</u>	<u>Sq. feet</u>	<u>% of Total</u>
Spalling	1600	0.14
Craze Cracking	600	0.05
Scaling	4500	0.41

Cracking parallel to tooled joints was 3000 linear feet (8.11%) of total tooled joints.

EXHIBIT 1

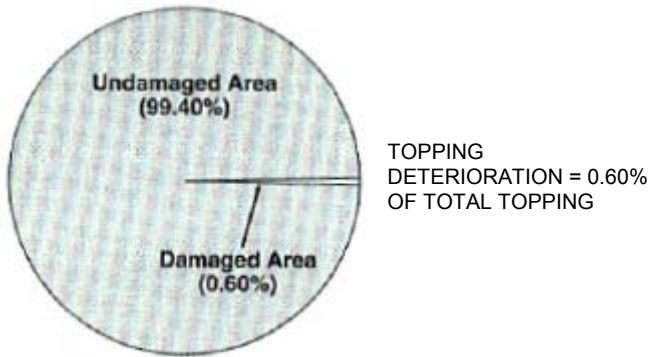
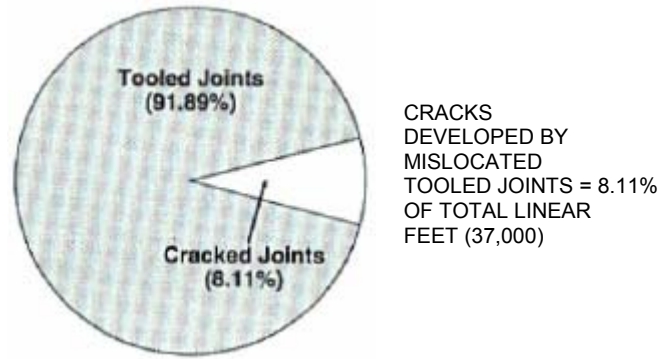


EXHIBIT 2



COMMENTS CONCERNING THE VISUAL SURVEY AND GENERAL COMMENTS

A & R ENGINEERING CO., INC., commented as follows:

1. The spalling is attributed to corrosion of embedded reinforcing with less than specified cover. ($\frac{3}{4}$ " on this project).
2. Craze cracking was probably caused by use of excessive water in finishing.
3. The scaling, confined mainly to a two bay area on the roof of "D" garage, appeared to have been caused by rain on the day of concrete placement prior to finishing and curing.
4. The parallel cracking is attributed to mislocation of the tooled joints with respect to the edge of the double tee flanges.
5. There was no evidence of corrosion of the mesh as a result of the parallel cracking.
6. There is little evidence of any maintenance or repairs having been made to the decks in the fifteen year period.
7. The decks have not been damaged by:
 - (a) water, snow, and deicing salts carried in by the cars.
 - (b) water, snow, de-icing salts or snow plowing on the roofs of the structures.

OPINION

The A & R ENGINEERING CO., INC., report was concluded with the following:

"In our opinion and experience, the IPANEX modified concrete decks on this project have proven to be more durable than comparable, unmodified concrete decks of the same age."

FOOT NOTE

In 1988, A & R ENGINEERING CO., INC., was commissioned to be the structural consultant for the A & B garage at the Philadelphia International Airport. This structure is of similar construction accommodating approximately 3,000 cars (900,000 sq. ft. of parking). Based upon prior experience, and performance, IPANEX was specified in the concrete topping of this garage which was opened in 1991.

REFERENCES

See IPA Technical Bulletins #1, 2, and 3.