Flying Wing

Eero Saarinens
Dulles Airport, 1962

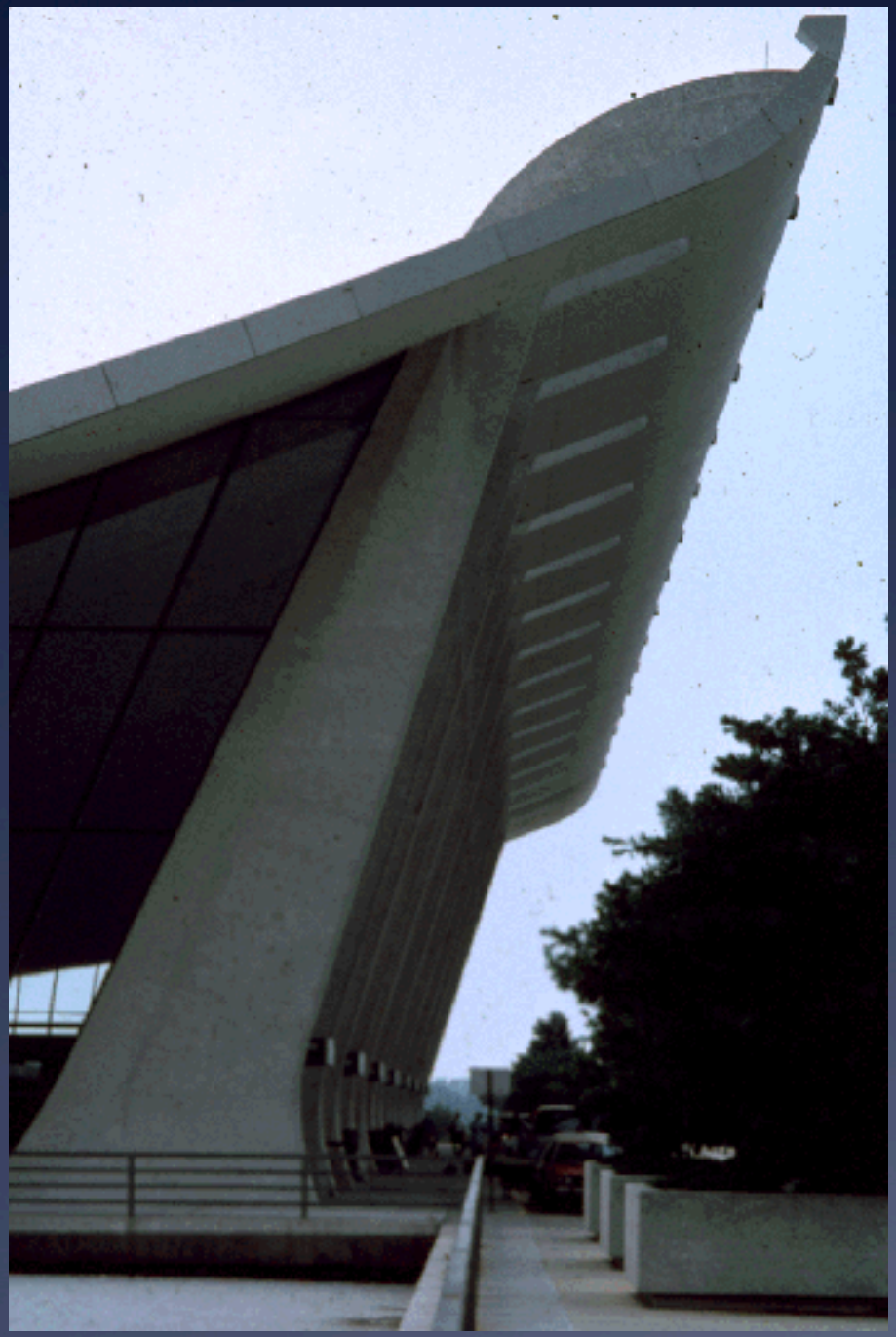
Eero Saarinen had a simple pallette of elements in this project, two columns and a curved roof. Very similar to the Lyon TGV station by Santiago Callatrava, Dulles Airport Terminal uses a very small number of elements repeated a large number of times to make the custom formwork affordable.

The curtain walls between columns are curved to form a plan shape that is stronger than a flat plane…. Similar to corrugations in cardboard.


B.O.A.C.

The side elevation begins to reveal additional complexity in the palette.
The roof is actually three components, two edge beams, and a curve made of a type of catenary draped set of cables / reinforcing poured in concrete.

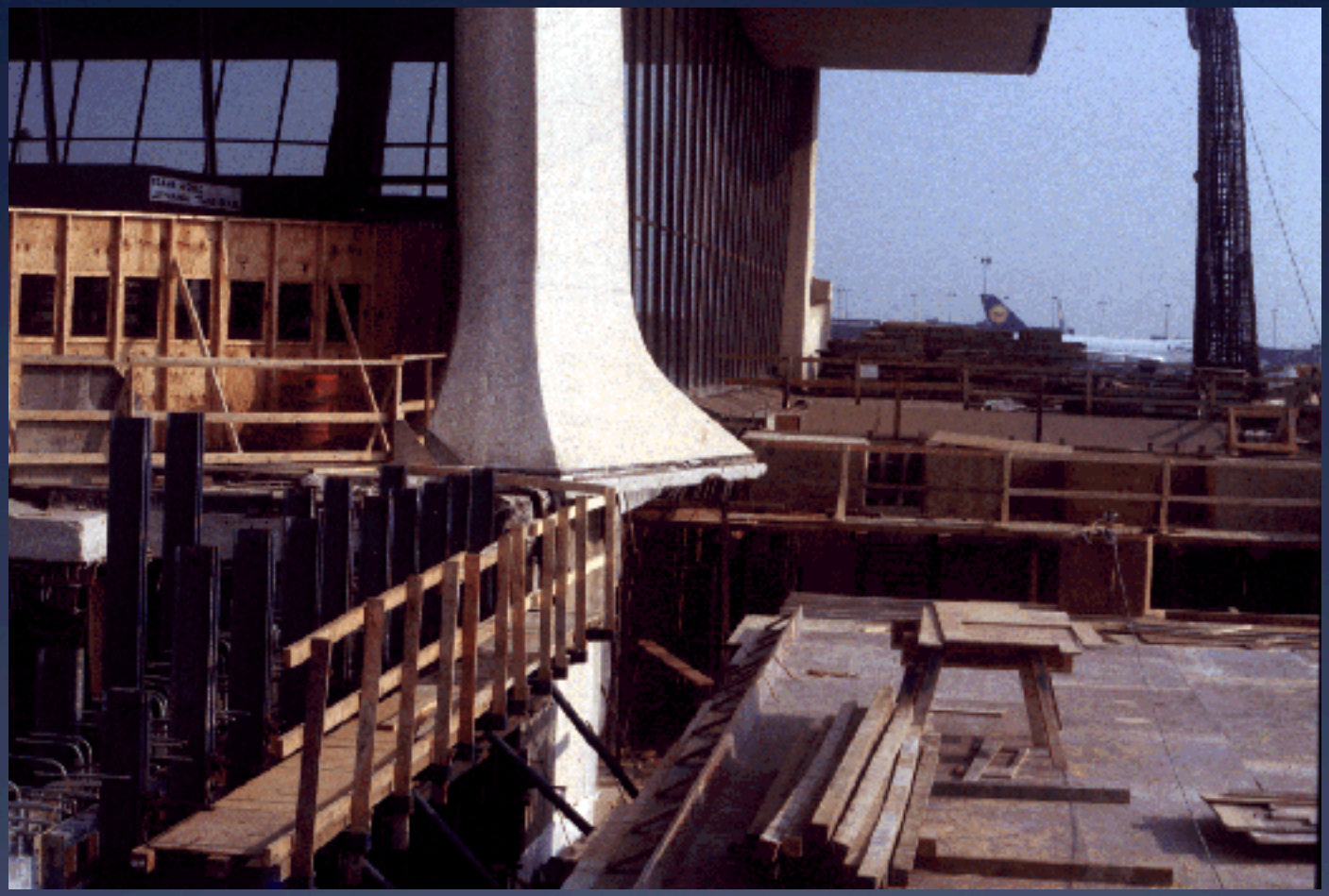
Curved edge beam



Saarinen's terminal is a landmark building in sitecast concrete. The fluid nature of concrete makes the expressive columns and roof possible.

The columns are inclined to statically resist the overturning forces of the catenary drape of the roof slab.

The columns increase in dimension at the base as an expression of load accumulation and transfer



The column's form is termed an 'expression' of the load because below the column is a small pier which carries the column load to the earth. The wider parts of the column are unsupported, part of a structural expression

In the mid 1990's the terminal was expanded.

This expansion followed Saarinen's original design and construction process.

Custom formwork for the columns was fabricated from steel. Due to the expense of the custom forms, only one set for each of two column sizes was made.

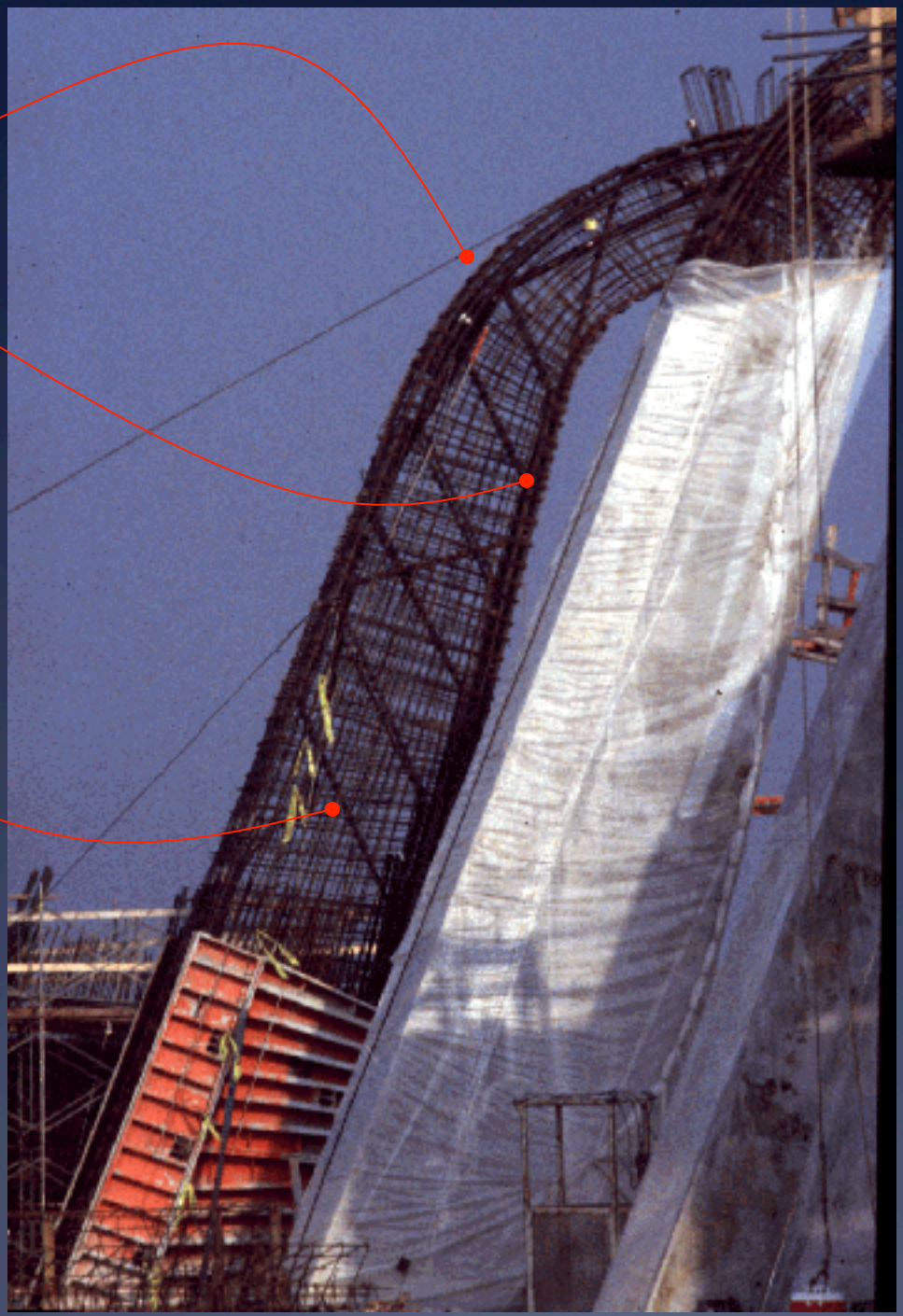
After the forms are removed, the columns were wrapped in poly….

Was this to

a. keep them fresh
b. keep out water
c. keep in water

Reinforcing is heaviest at the top and bottom of the column.

The reinforcing seen in the middle of the column is mostly temperature steel to minimize cracking

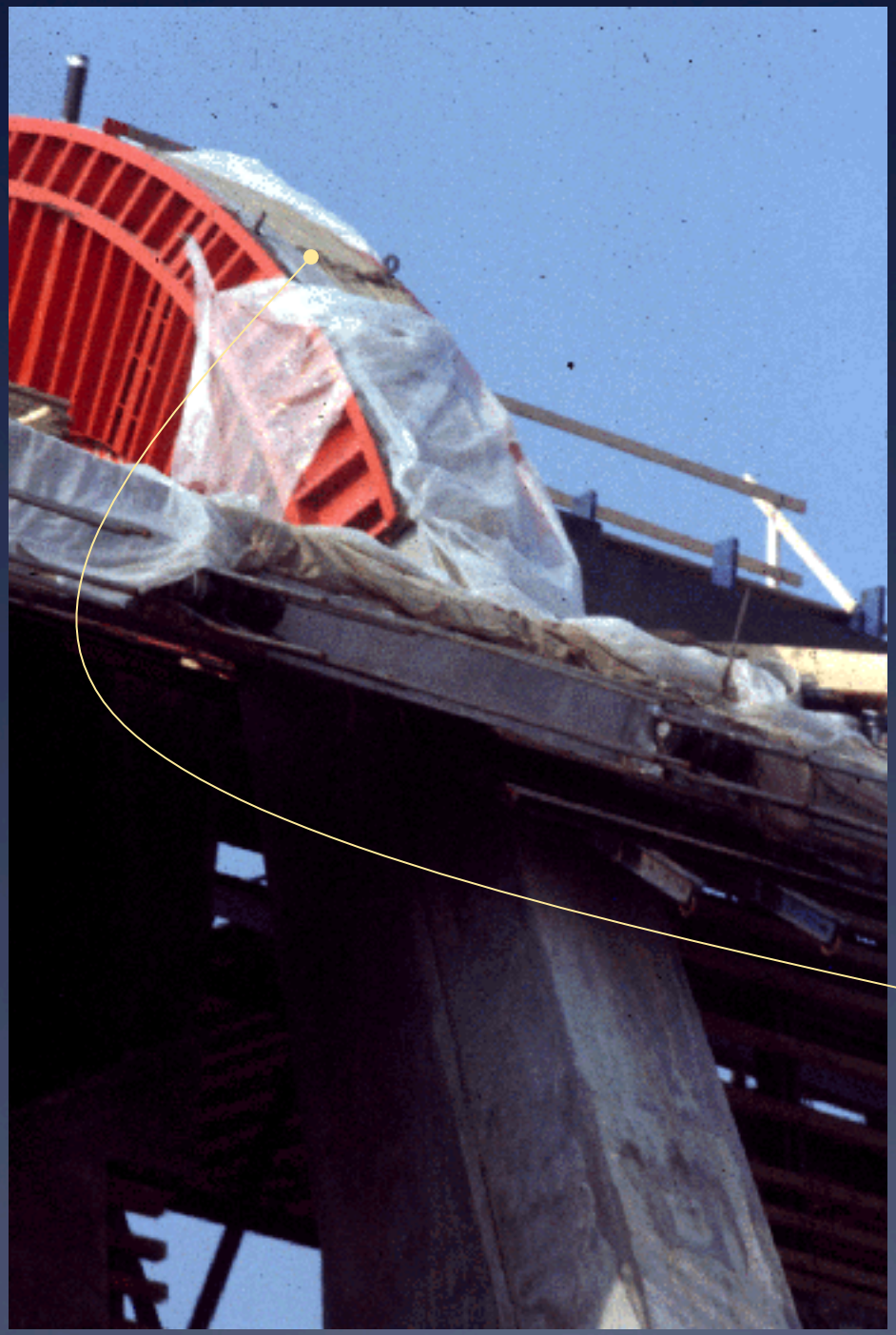


The heavy reinforcing (#18’s!) from the top and bottom of the column converge at the column head where it will ultimately connect to the curved roof edge beam.

When concrete is poured on sloping surfaces, it needs to be restrained from flowing downhill (especially with plasticizers in the mix)

The formwork here uses top forms to restrain the concrete and access doors to fill the forms


Top form
Leaks or spills?
Access door

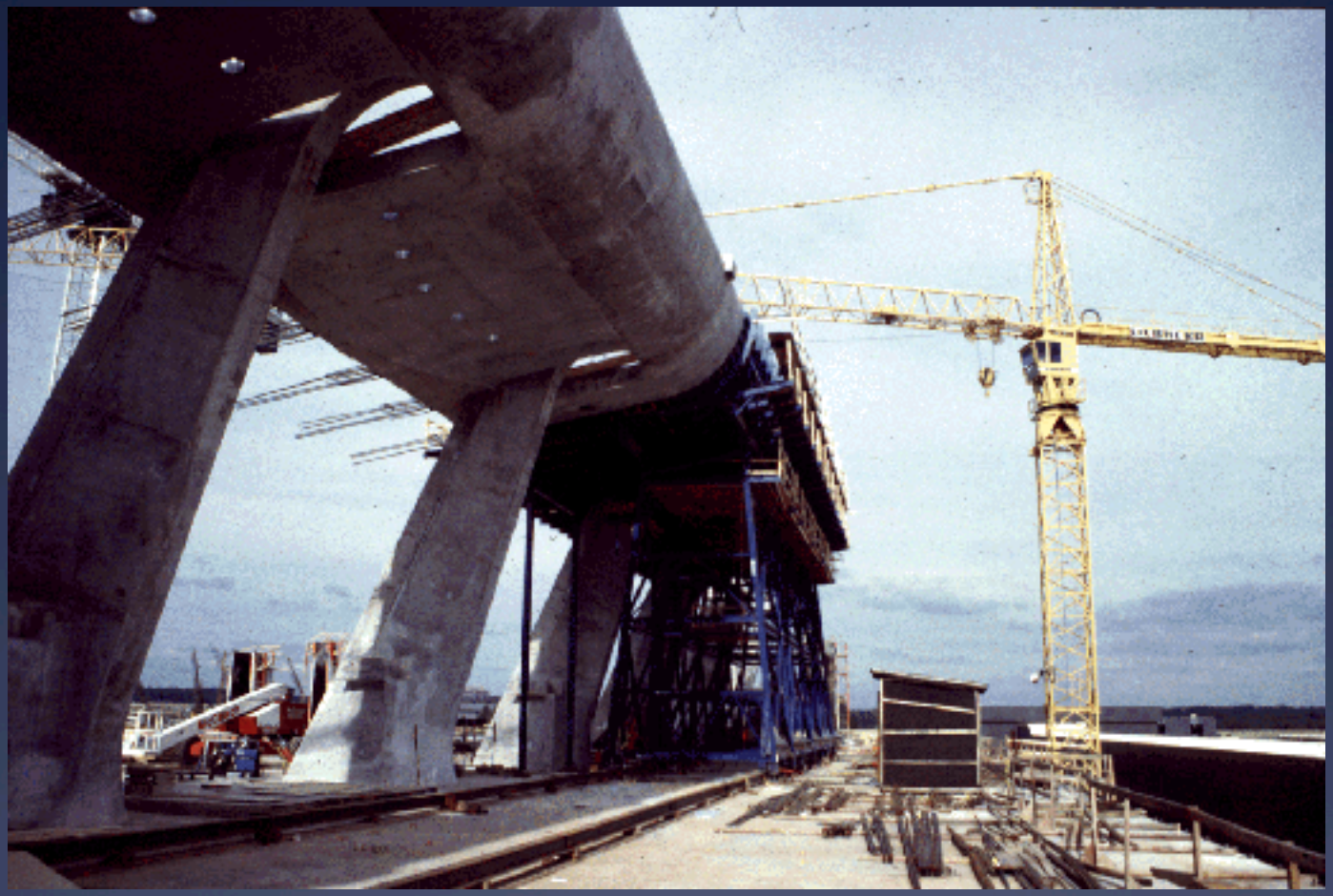


The access doors used to fill the lower part of the top form leak a bit.

Any form leak allows water & cement paste to flow out of the form, usually leaving a honeycomb.

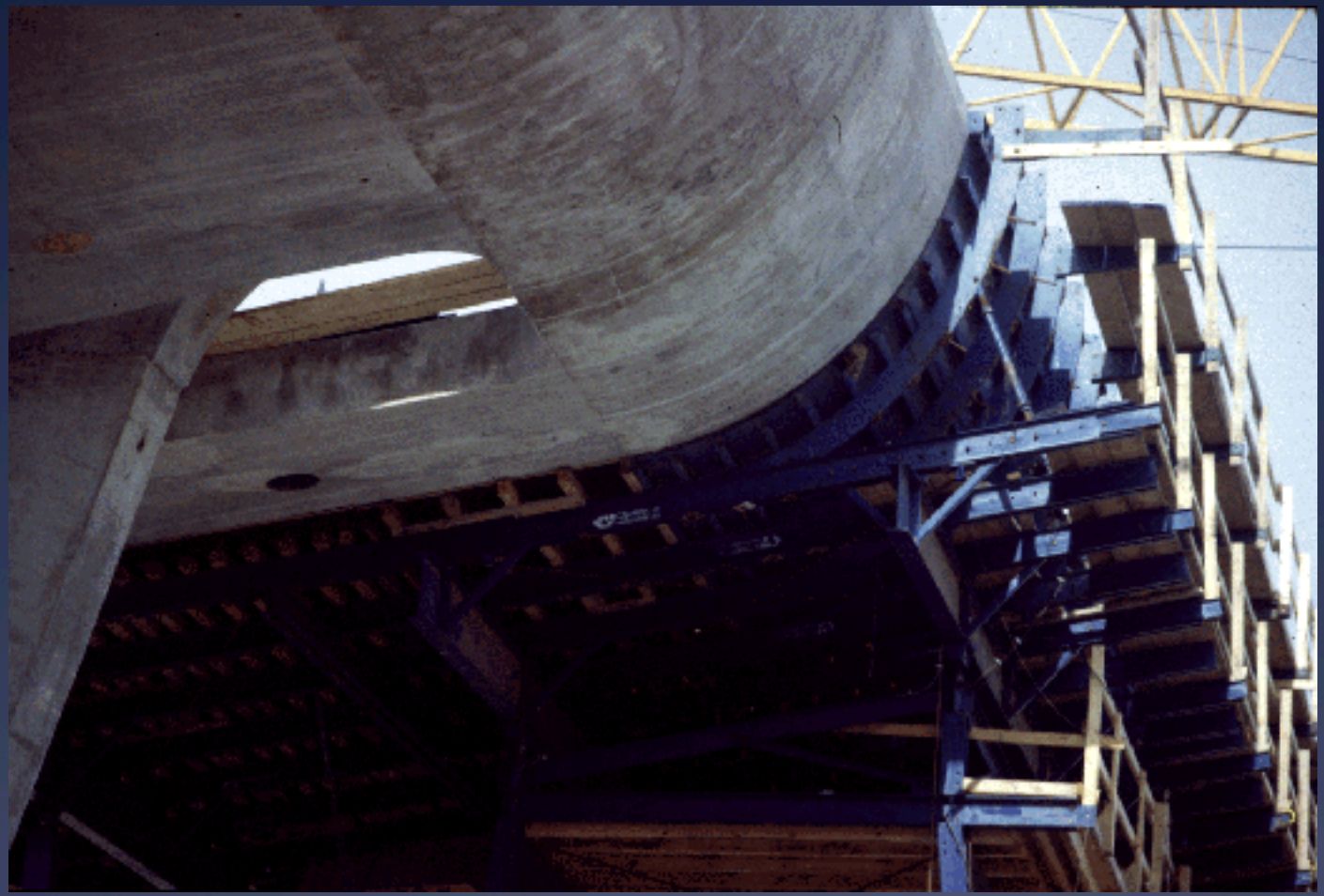
This one is pretty small and won't affect the strength of the column

The massive curved edge beams are poured on a form that rolls along on rails!



The form is static during the pour. But it is common on high rise elevator cores to have the forms slowly creep vertically during a pour that begins at the footing and doesn't stop until it tops out at the sky. *(Slipforming)*

So the edge beam is also made by a custom steel form that is re-used many times for cost effectiveness



The message is that you ***can*** have custom forms….if your project uses the forms many times over!

The inside edge of the perimeter beam has heavy reinforcing extending to be tied in to the catenary roof reinforcing.

When poured , the rebar will tie the edge beam and roof slab together to work as one structural unit.


CAR-BRO