Benefits & Advantages of a CIP Parking Structure

Concrete Council of St Louis
Professional Engineers Seminar
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CONCRETE COUNCIL

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Ceco Concrete Construction


Site Cast Parking
Your long term low cost solution

Agenda

- Design Collaboration
- Structural Options
- Pricing Considerations
- Schedule & Time Considerations
- Design Flexibility
- Appearance Options
- Performance
- Quality Concerns
- Constructability

Design Collaboration
The dream scenario

- Owner
- Design Team
- Contractor

Owner's Perspective

I need a place for my employees to park their cars, it can't cost too much, but I want it to look nice …and I needed it yesterday

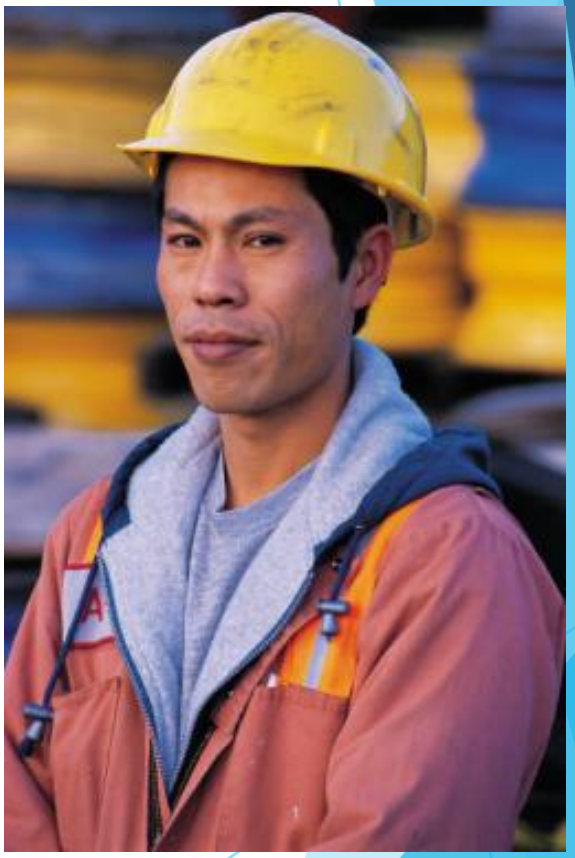
Designer's perspective

I need to design an affordable parking structure …that looks good …and that the patrons will appreciate using.

I want it to be something I can take future clients to and be proud of.

Contractor's perspective

I need to produce a parking garage that meets the owner's budget…that my team can build…and that won't cause headaches in the years ahead.



Perspective Summary

Stake Holder	Owner	Designer	Contractor
Cost			
Speed			
Appearance			
Performance			
Quality			
Construct-ability			
Long term performance			

Structural Options

- Generally you have two competing structural systems widely used and available for parking structures:

Pre-Cast and Cast-in-Place

Pricing Considerations

- Depending on a number of variables including market conditions, contractor preferences and durability considerations, *either system can be made to appear lower cost during the budgeting phase*
- Common denominator - $/space

- CONSIDER LONG TERM COSTS
  - i.e. Maintenance

Initial Cost

"It has been our experience that preliminary projected savings by pre-cast double-tee systems may not be realized in the finished project"

Ron Saxton/International Parking Design

Initial Cost

"Costs are typically fairly even"

Thomas Butcher, Walker Parking Consultants

Bid Cost

- In head to head competitive bids, cast-in-place generally proves to be the low cost option.
- Why?
  - Greater competition
  - Increased leverage of local labor force

11th & Oak Parking Structure – KC, Missouri

- 1,340 cars
- 383,000 square feet
- 9 Levels
- Double Helix
- Retail at street level

11th & Oak Parking Structure

- Competitively bid project
- Two options at bid time
  - Pre-Cast and Cast-in-Place
- Cast-in-place proved to be the most cost effective structure!

11th & Oak Parking

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11th & Oak Parking Structure

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Budget Considerations

- Be sure that each system analyzed is a complete package that includes the following:
  - Foundations
  - Equivalent durability measures, i.e.:
    - Epoxy-coated rebar
    - Corrosion inhibitor
    - Post-topped precast planks
  - Skin – exterior treatment
  - Long term maintenance cost

Speed

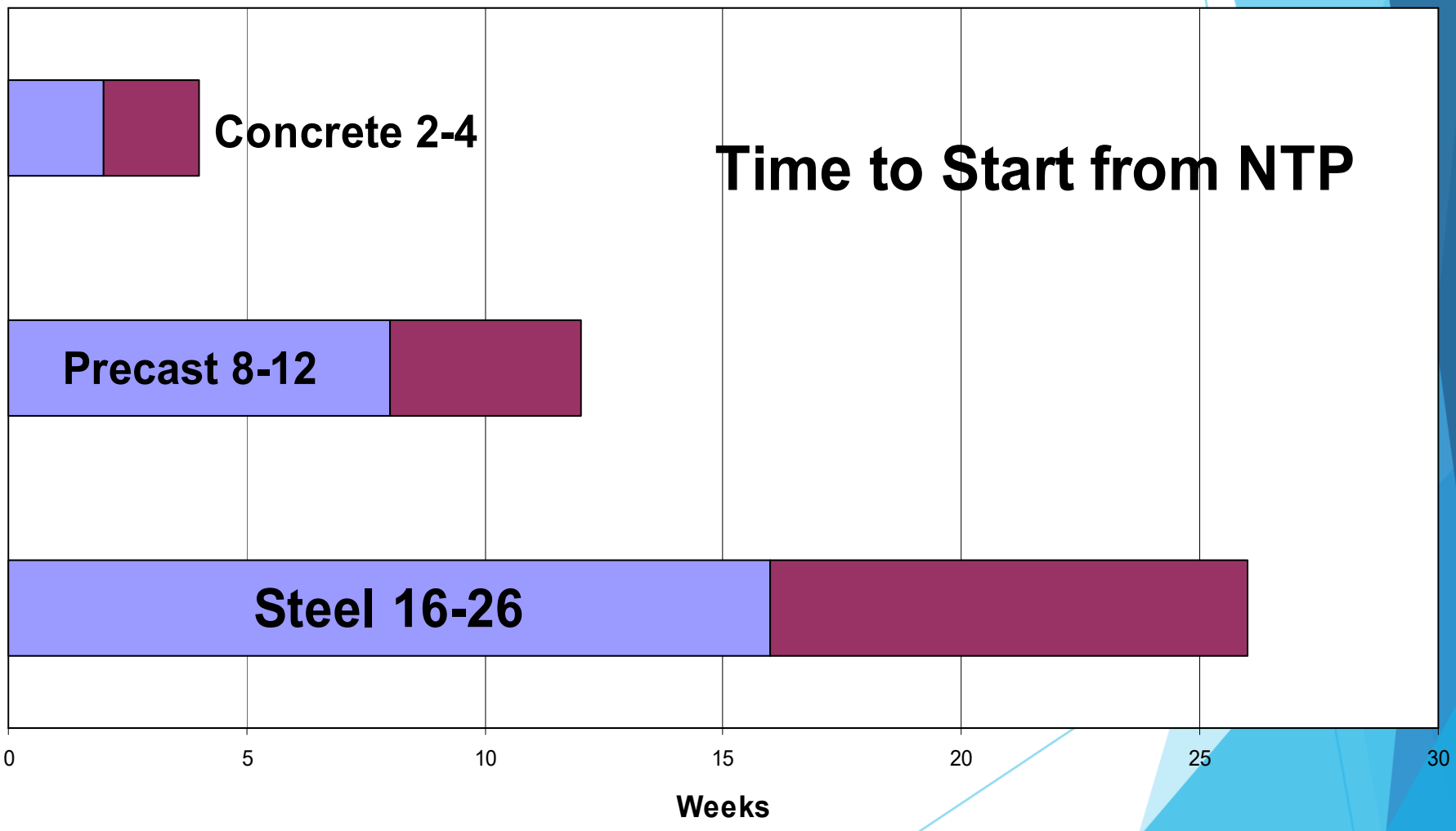
- CIP - Key considerations
  - Faster start-up
  - Speed of construction
  - Greater design flexibility

Time

"Design build, poured in place framing is the most expeditious way to build a parking garage. Site-cast starts faster than other systems."

Huber Hunt Nichols

Lead Time


Concrete 2-4
Time to Start from NTP
Precast 8-12
Steel 16-26
0
5
10
15
20
25
30
Weeks

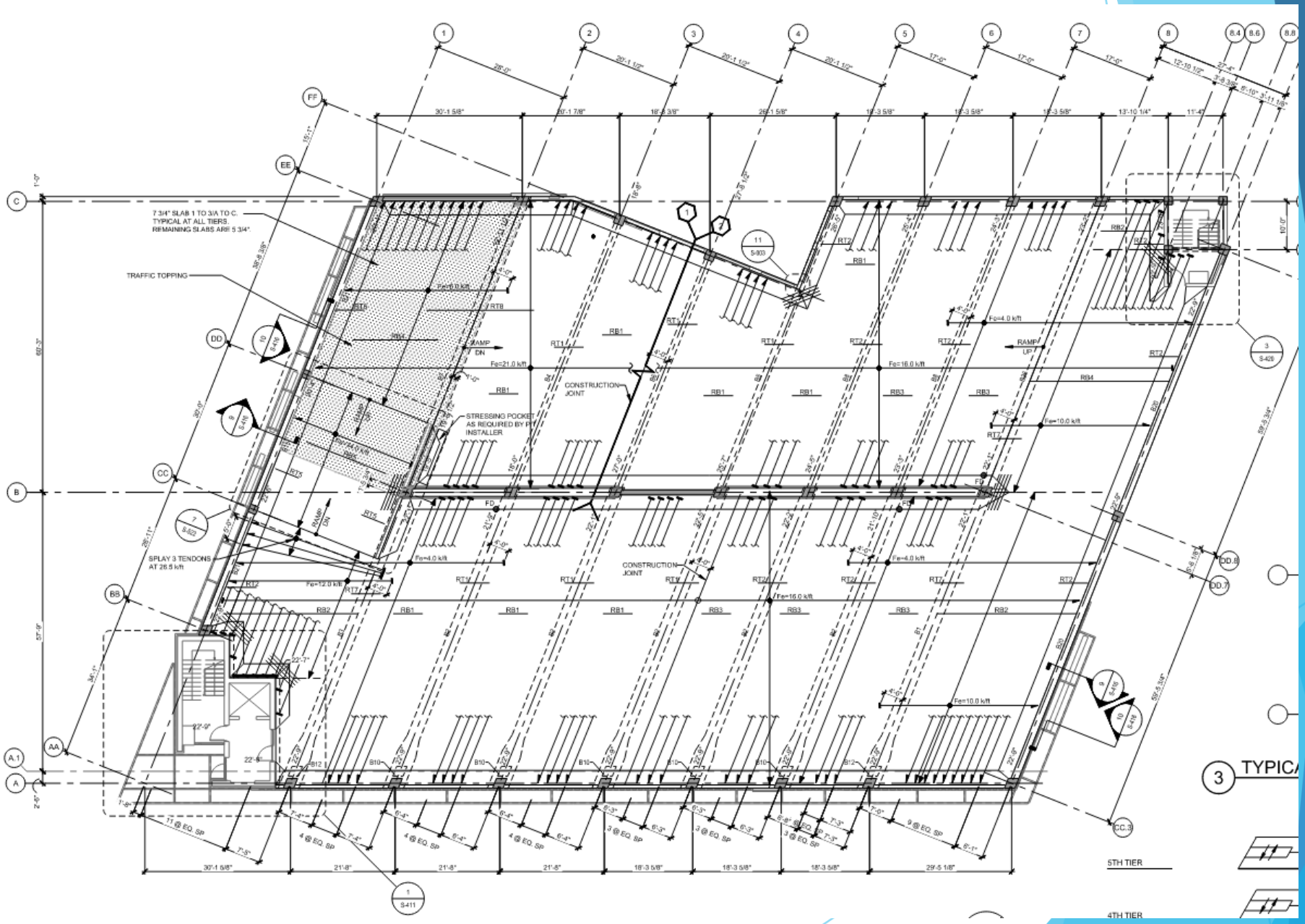
Speed of Construction

Project	Location	GBA	Avg. GBA/WK
MAC	Minneapolis	3,000K	45K
Aladdin	Las Vegas	1,400K	30K
Stratosphere	Las Vegas	650K	40K
Wells Fargo	Des Moines	470K	13K
11th & Oak	Kansas City	383K	16K
SLU Garage	St Louis	360K	18K

Design Flexibility

- Changes can be made up to the time of pour – there is no lead time for casting, transporting, and erecting special members.
- Buildings can more easily be configured to fit project sites.

CIP garage configured to fit project site



Appearance Options

- Traditional pre-cast panels
- Site-cast spandrels
- Open – w/ PT barrier cables
- Architectural treatments
- Cast-in-place barrier walls
- Other

Traditional Pre-Cast

- Shallow depth

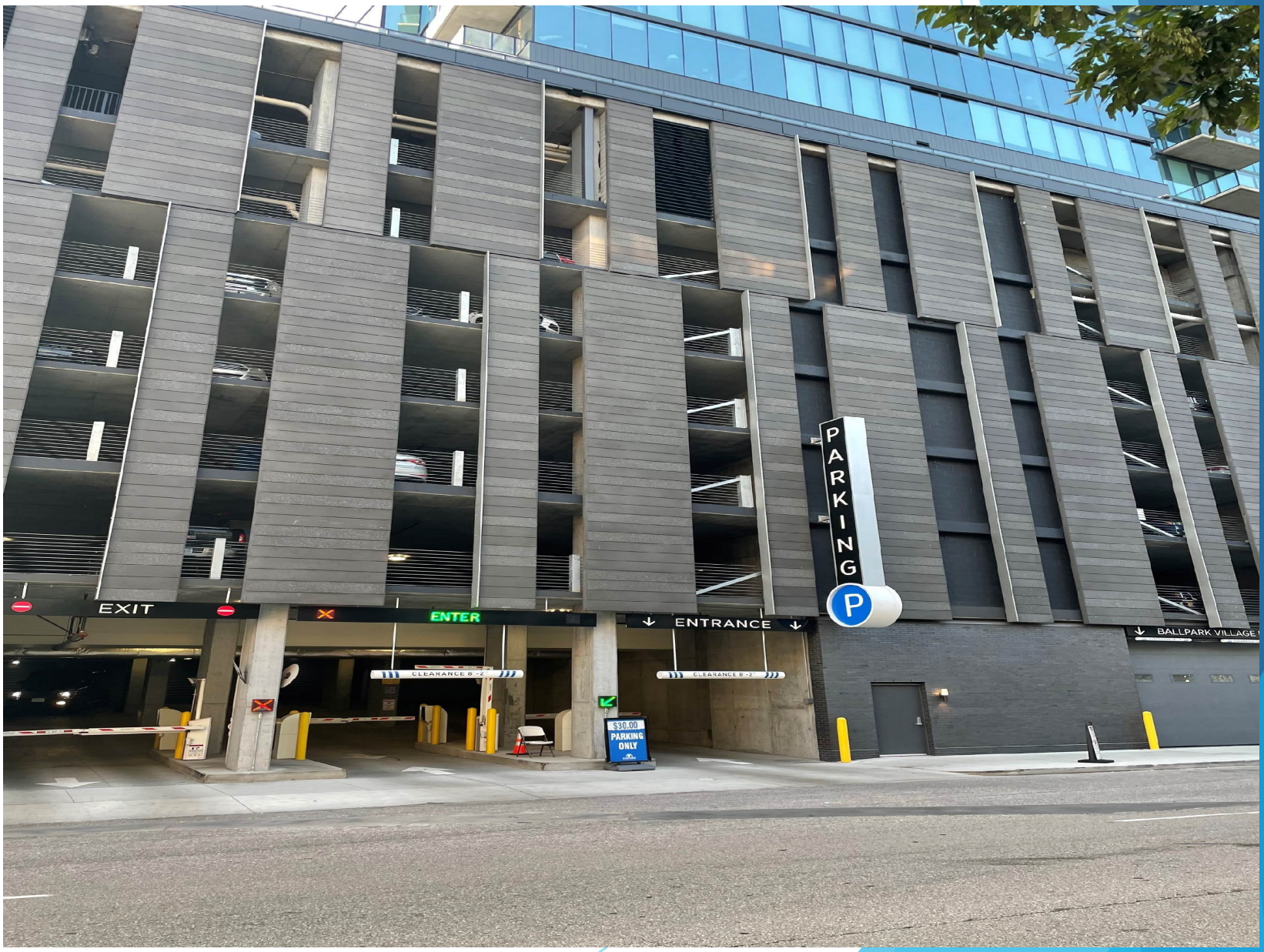
Site-Cast Spandrels

Open – Barrier Cables

Open – Barrier Cables

Architectural Treatment

Other Precast Skins



Site Cast Barrier

- 2” Expansion joint at columns

Appearance

- The appearance of your building is only limited by the design team's imagination (and your budget)!
- Or said another way, site cast parking gives you more low cost alternatives for the outward appearance of your parking structure.

Does Appearance Matter?

"Parking is customers' first and last impression of any place they drive to"

Jerry Fondaw – president Signal Park USA


SAINT LOUIS UNIVERSITY
OLIVE


QUICK PARK
10. 3. 2001

Performance

- Time to enter/exit
- Layout – site plan
- Traffic pattern
- Parking pattern
- Lighting
- Security
- Communication

Performance – IT MATTERS

- These performance criteria are all reasons why the end user may or *may not* want to use the garage
- What good is a low cost garage if the end user doesn't want to use it?
- There are consultants who deal specifically with all of these issues – too big for this presentation

Performance

"Smart parking is smart business. If customers find parking difficult or unsafe in one center, they'll do their shopping somewhere else."

Danial Burgner – Sr. V.P. Caruso Affiliated Holdings – a CA based shopping center developer.

Functional Layout

- Affects
  - Time to enter/exit
  - How the garage fits on the site – traffic impact
  - Flow of traffic in the garage
  - Parking pattern – 90 degree or angled
  - Number of spaces - $/space

Layout Options = Flexible

- Number of bays
- Typical Bay size
- Number of ramps
- Number of flat bays
- Configuration - double helix
- Speed Ramps

Security/ Lighting – CIP Advantages vs. Precast:

- Better sightlines both Int. & Ext. Bays
- Fewer Downturn beams for better lighting
- Open to Sunlight – PT barrier cables
- SAFETY = COMFORTABLE
- Natural Lighting during the daytime.

Performance - Lighting

"Beam and slab construction creates a more open feeling"

"With double-tee construction, it is more difficult to achieve uniform lighting. Also, it costs more to light a pre-cast garage than a cast-in-place garage."

Del Bishop – McCarthy Construction

Performance - Lighting

- With site cast, the open bays between structural beams allows for more even light distribution
- Light wells or “light coffins” created by double TT construction makes it difficult to achieve uniform light distribution. Usually you need more fixtures.

Lighting Pre-Cast

Lighting – Pre-Cast

Lighting – CIP


RESERVED
PARKING
Level
P3
Level
P3
← Elevators

Performance = Security

- The openness of a garage translates into the “feeling” of security

Security – Pre-Cast

- “Lite walls” limit site lines
- Shear walls limit site lines
- Repetition of structural members acts to lower the ceiling height
- Depth of spandrel beams closes in the structure


Park
3. 28. 2003


3. 28. 2003

Security = Cast-in-Place

- Open bays between floors at ramps

Security = Cast-in-Place

- Moment frames eliminate shear walls

Security – Cast-in-Place

- Open bays between beams allows for light distribution

Security – Cast-in-Place

- Non load bearing end bays eliminates need for below slab structural framing

Performance - Communication

"The pre-cast double-tee system, … significantly limits the sight lines and also the maximum height of the signs to be used"

Ron Saxton – International Parking Design

"Increased clear span between beams provides more "openness" allowing for better visibility of graphics and better lighting distribution"

Art Stadig – Walker Parking

Communication – CIP

Communication - TT

Quality – Durability

"Principal causes of deterioration are de-icer salts and water entering the structure through joints and cracks. Post tensioned garages are superior"

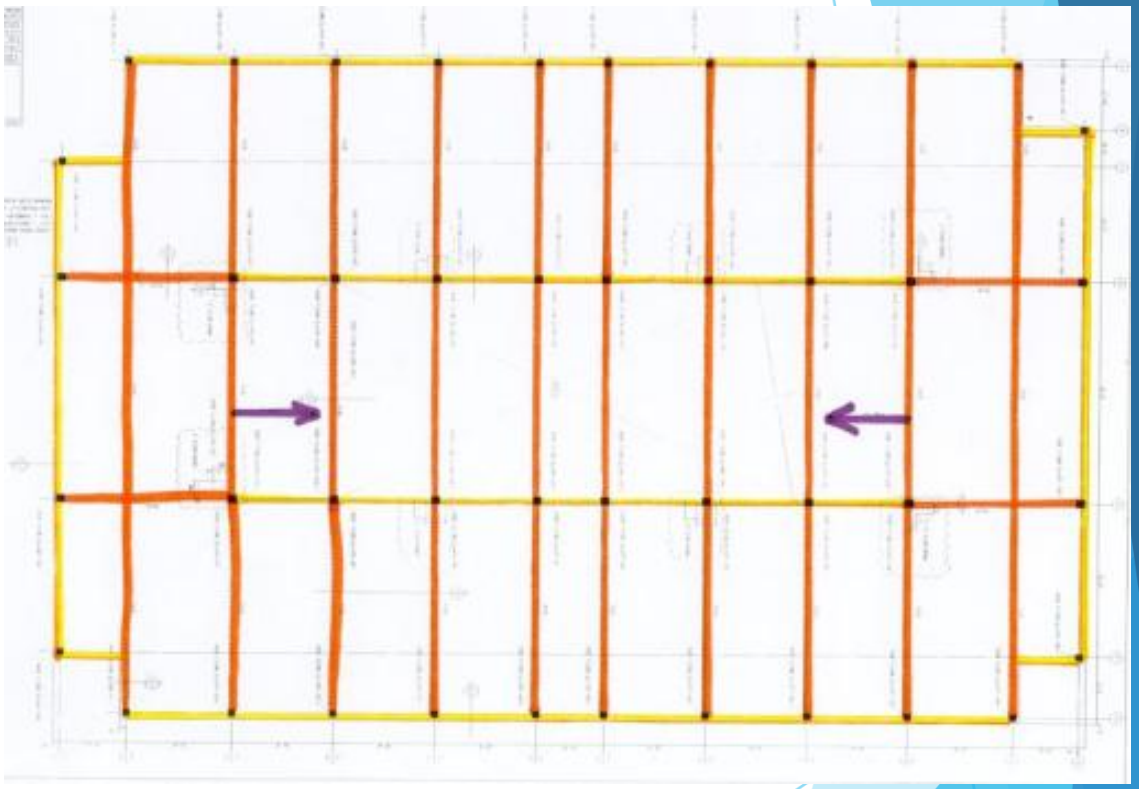
Carl Walker – Kalamazoo, Michigan

Durability – Key Consideration

- It’s the number of joints
- Feet vs Miles

Feet vs. Miles

- Typical Level
  - CIP – 560 feet
  - TT – 1mile (5,200 feet)



Joint Repair - Precast

- It's not a question of **if** but **when and how much**!

Cost of Joint Repair

Average life: 3 to 5 years

Typically 30% to 50% of joints affected

Process is: rout, clean, replace

Costs are typically $4.00/LF

Lee Popovich – Structural Preservation

Cost of Joint Repair

- In any financial analysis – the present value of joint repair 5, 10, 15 years down the road is substantial!
- How long is everyone's time horizon?
- Ignoring the long term maintenance cost is like pretending college will be free for your kids – it just won't happen!

Cost of Joint Repair

Site Cast Quality

- Epoxy coated rebar
- Encapsulated PT cables & anchors
- Corrosion inhibitors, water reducers, increased concrete coverage
- Concrete additives – micro silica

- *Important to compare apples to apples!*

Site Cast Quality

- Specify a low w/c ratio (0.4)
- Specify air entrainment (5% to 6%)
- Specify hot and cold weather placing and curing procedures
- Minimum number of joints
- Adequate cover on reinforcing

Site Cast Quality – Joints

- Site cast construction minimizes the number of joints in the structure – it's monolithic!

Monolithic Construction

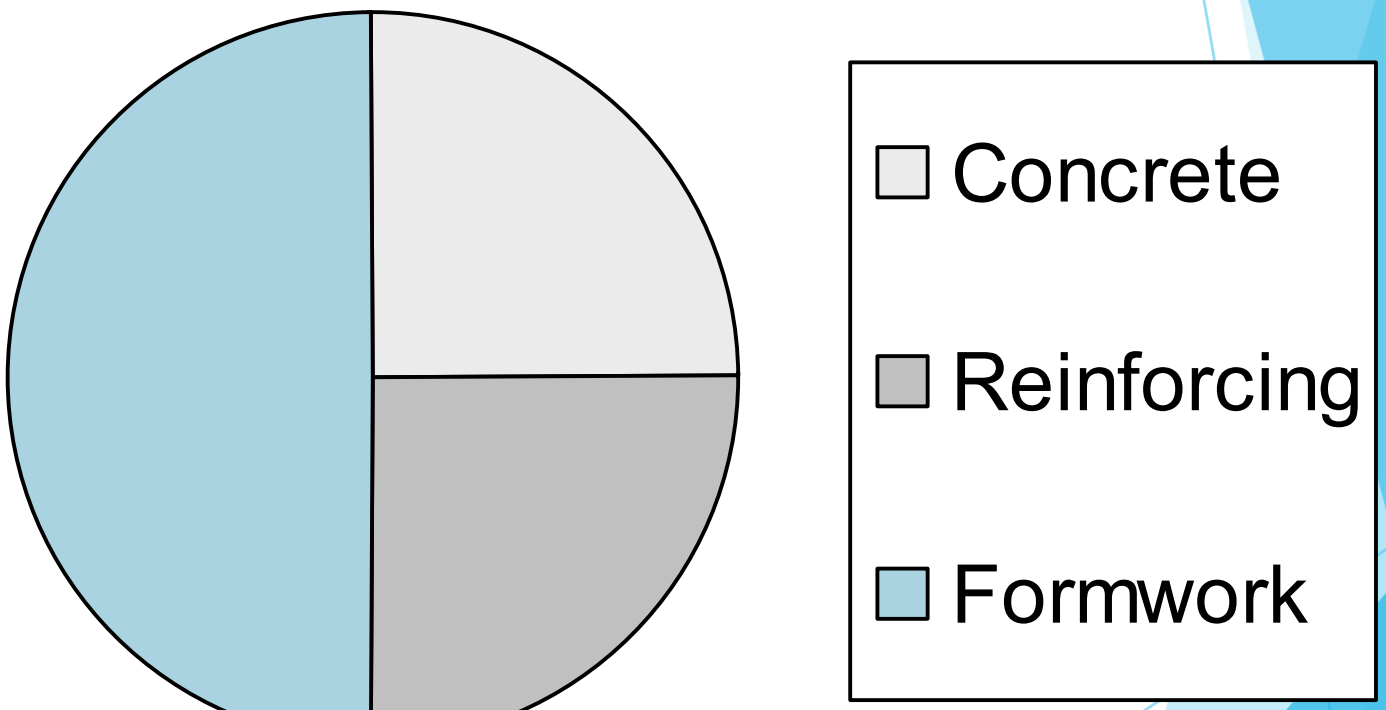
- Longer lasting structure due to lack of movement differentials. (It moves as a unit instead of piece by piece)
- Monolithic construction has redundant load transfer features minimizing chances of catastrophic failure

Constructability / Ease of Construction

- Site cast utilizes local suppliers and subcontractors
  - Materials readily available
  - Utilizes the local work force
  - Creates a more competitive environment
  - Money stays in the local community

Ease of Construction – Formwork

Impact of Formwork on Frame Cost



The Steel Beam System

- Pre-sized steel troughs
- Form repetitively sized post tensioned beams - generally 55’ to 60’
- Beam system carries all or part of slab framing
- Minimizes loose framing material
- Minimizes reshoring

Framing Economies

- When properly designed, a garage framed using this system will reap savings by:
  - Reducing **labor cost**
  - Lowering **material cost**
  - Increasing as-cast **quality finish**
  - Increasing **construction speed**

Key Formwork Considerations

- Standard Beam Sizes
- Bay size and repetition
- Slab/Beam intersection
- Beam/Column Intersections
- Bumper walls
- Ramp conditions
- End Bays
- Exterior treatment
- Repetitive column sizes
- Expansion Joints

Standard Beams

- Beam size is driven by span and desired system depth
- 14” x 36
- 16” x 33 to 36
- 18” x 33 to 36

- 32” beams should be used with thin slabs; beam side and beam trough dimensions may be incompatible

Bay size & repetition

- Pick a repetitive bay size
  - Minimizes form cost
  - More visually appealing from the outside
- We want to use the same panels throughout the building
- Also easier on rebar/PT installation

Turn Bays

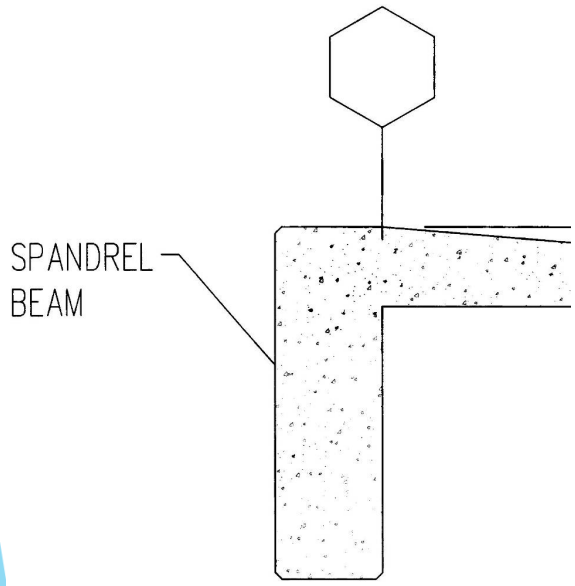
- Turn bays generally require a wider bay than the typical module
- Girders

End Bays

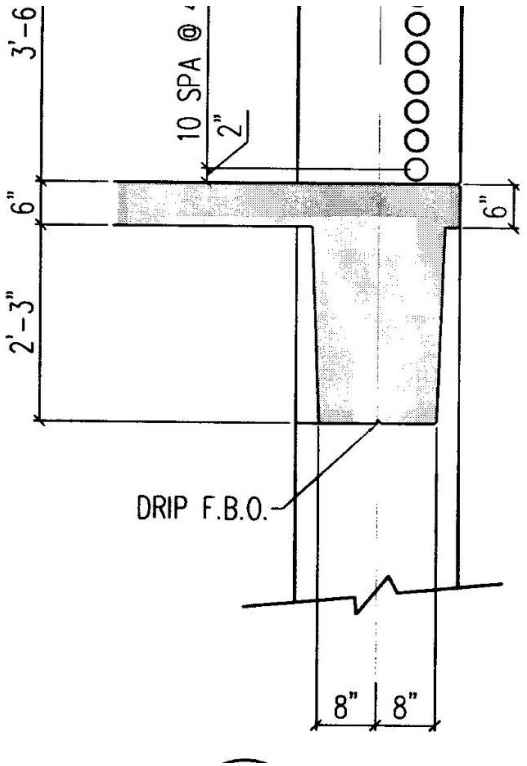
- The last bay on either end of the structure can be the “odd” sized bay on the project
- End beam options
  - Conventional down turn spandrel
  - Steel beam down turn with slab lip
  - Upturned spandrel

End Bays

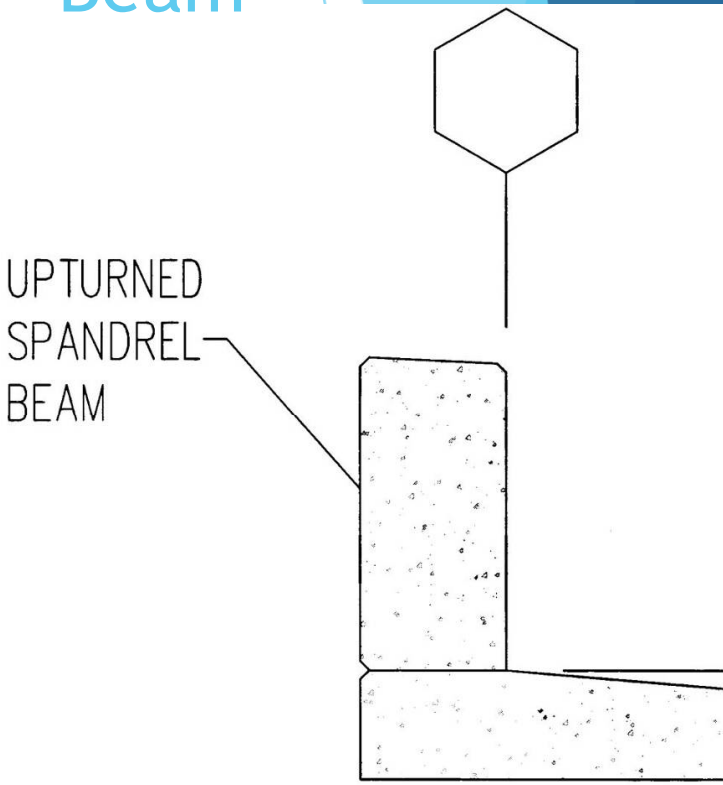
Conventional Down Turn



Steel Beam Down Turn

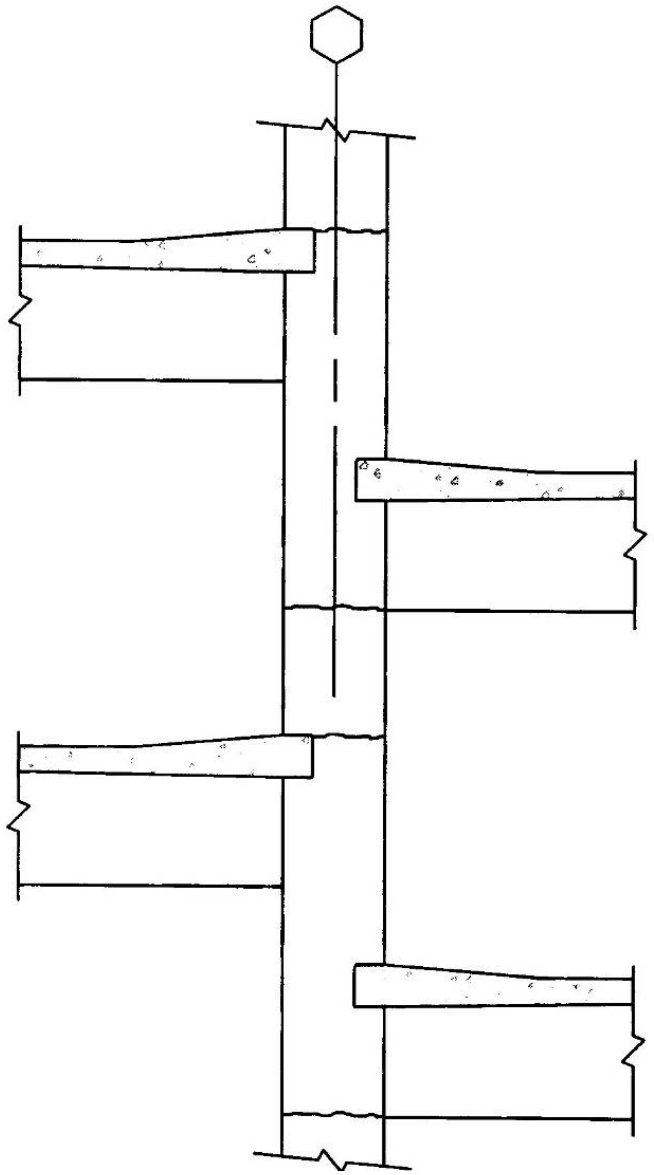


Upturn Beam



Bm/Col Intersections

BM/Col Intersections



Ramp Separation

- Separation between ramps – many options
  - PT barrier cables
  - Bumper walls
  - Other – steel barriers, stop blocks, curbs, masonry …

PT – Barrier

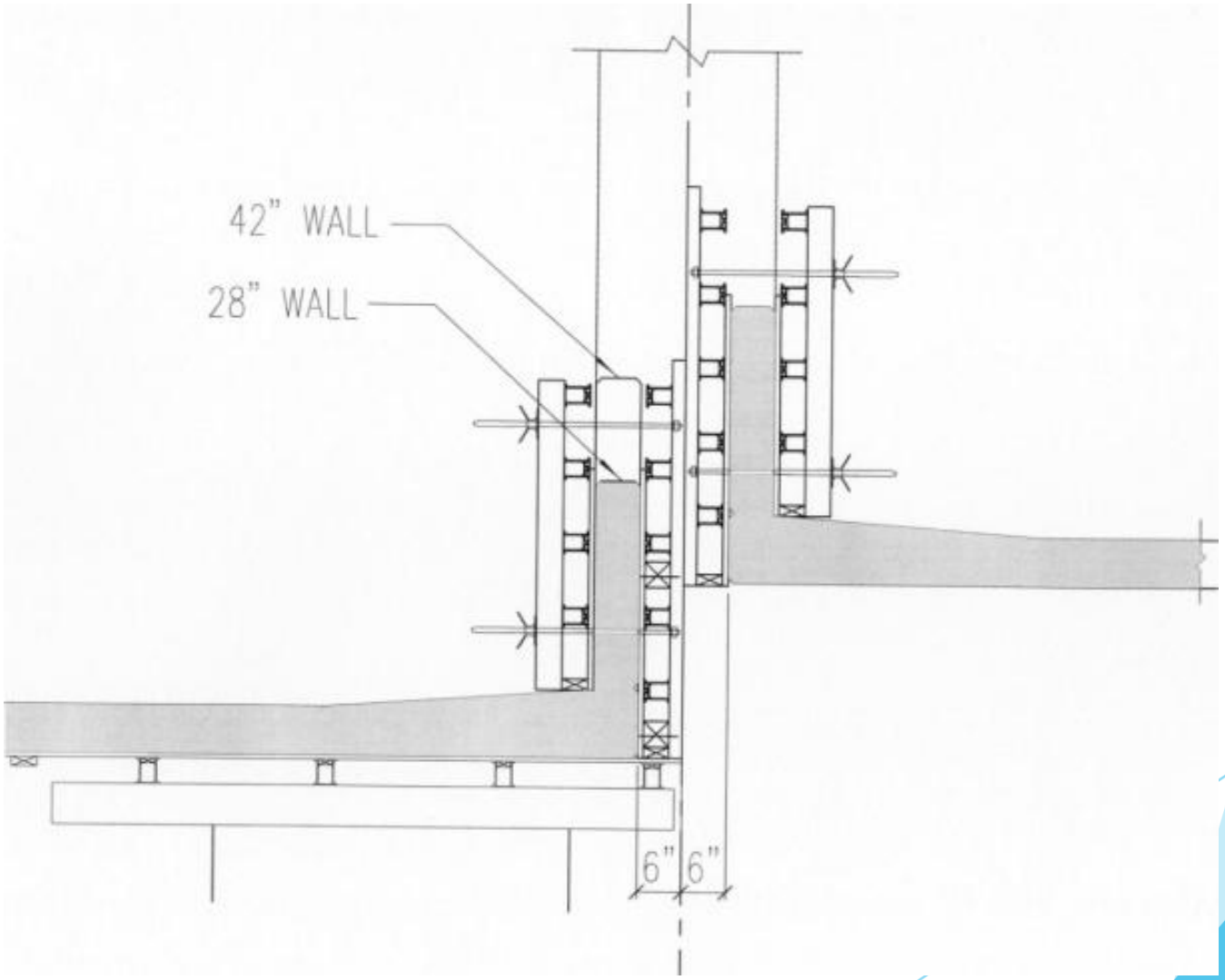
- Maximizes natural light
- Enhances openness of structure
- Increases security
- Cost effective
- Can be placed in front of non-structural skin

PT Barrier Cables

- Surface mount

PT Barrier - Thru sleeve

Bump Walls – Full Ht.



Bump Walls – Partial Ht.

Constructability

- There are lots of other factors that can make for a good CIP design, but beyond the scope of this presentation
- Typically the local contractor or design team has the necessary experience and relationships to look at these other factors
- Reach out to contractors early on in the design
- Contractors like Ceco are happy to provide design assist and input

The Last Need – Long Term Performance

Long Term Performance

- Choose cast-in-place concrete when you want a parking structure that:
  - Maximizes **design** layout **flexibility**
  - Provides multiple **appearance options**
  - **Functions well** – that is the end user is drawn to use the building!
  - Takes advantage of local **market forces**
  - **Will stand the test of time**!

Long Term Performance

- Long term performance will take care of itself when the design and construction team harnesses industry knowledge and leverages the local competitive marketplace to construct a site-cast post-tensioned parking structure
- www.post-tensioning.org; www.cecoconcrete.com, www.portcement.org; www.crsi.org


Site Cast Parking
ANY QUESTIONS?
Your long term solution