Pre-Cast Concrete Structure : Double Tees + Single Tees

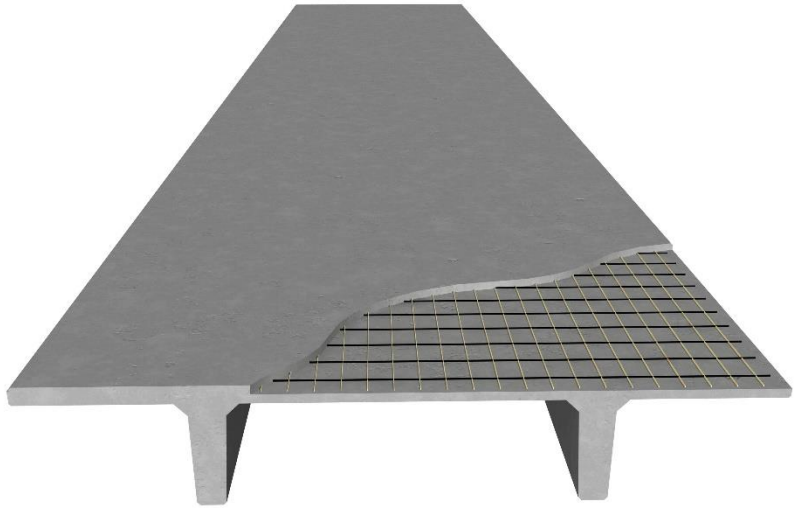
Stevenson . Trishita . Lennart
Prof. Aptekar . Prof. Portelli

Double Tees + Single Tees : Maximum Span

- Typical width of the structural shapes can be 15’ or 16’ and up to 60’ in length.
- Typical span to depth ratios :

  Floor – 25’ to 35’
  Roof – 35’ to 40’

- The precast concrete components often are topped with 2” concrete.
- The Tees are supplied with a standard broom finish.
- http://www.youtube.com/watch?v=HLnV-fdf9kQ



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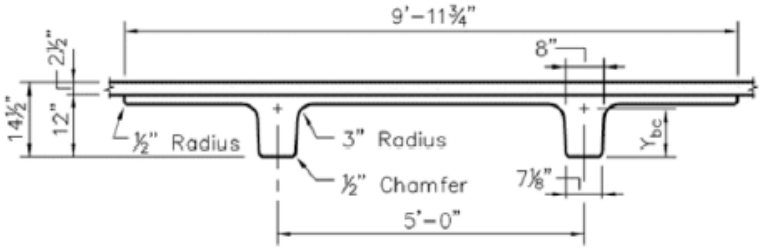
Double Tees + Single Tees : Different Types of Spans



SECTION PROPERTIES

I =	7397 in^4	Z_{tc} =	2605 in^3	Z_{tf} =	4207 in^3	Z_{bc} =	722 in^3
w =	74 psf	Y_{tc} =	4.26 in	Y_{tf} =	1.76 in	Y_{bc} =	10.24 in

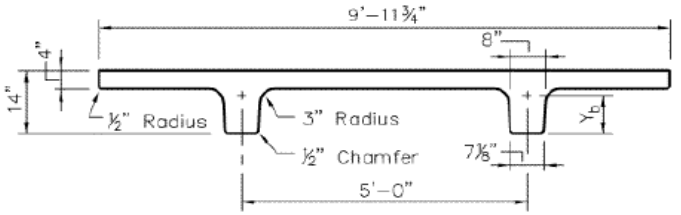
ALLOWABLE SUPERIMPOSED LOAD (in pounds per square foot)

SIMPLE SPAN (in feet)																	
Number of ½" Ø strands per tee	20	22	24	26	28	30	32	34	36								
4 (straight)	96	65	38														
4 (harped)	107	78	49	27													
6 (straight)	141	99	67	41	22												
6 (harped)	181	137	99	69	45	26											
8 (harped)	**247**	**190**	**143**	107	78	55	36	20									
10 (harped)	**304**	**234**	**181**	**139**	**105**	78	56	38	23								

NOTES:

1. The standard top flange reinforcement is **WWF 8x4-W2.9/W2.9**, and the maximum safe uniform load on the flange with this reinforcement, without the topping, is **80 psf**. The maximum safe concentrated load without the topping is **500 lbs**.

Topped Thin Flange



SECTION PROPERTIES

I =	7383 in^4	Z_t =	2012 in^3	Z_b =	715 in^3	A =	638 in^2
W =	69 psf	Y_t =	3.67 in	Y_b =	10.33 in		

ALLOWABLE SUPERIMPOSED LOAD (in pounds per square foot)

SIMPLE SPAN (in feet)																	
Number of ½" Ø strands per tee	20	22	24	26	28	30	32	34	36	38	40						
4 (straight)	96	69	49	33	21												
4 (harped)	107	78	57	40	26												
6 (straight)	149	113	86	64	45	30											
6 (harped)	180	139	108	83	63	46	32	20									
8 (harped)	**247**	**192**	**151**	**118**	92	71	54	40	28								
10 (harped)	**299**	**235**	**186**	**148**	**118**	**94**	74	58	44	32	22						

NOTES:

1. The minimum top flange reinforcement is **WWF 4x4-W2.9/W2.9**, and the maximum safe uniform load on the flange with minimum reinforcement is **180 psf**. Additional flange reinforcement will be required for loads in excess of 180 psf.

Un-topped Thin Flange

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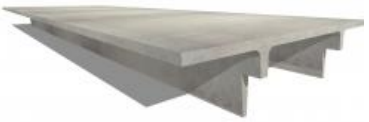
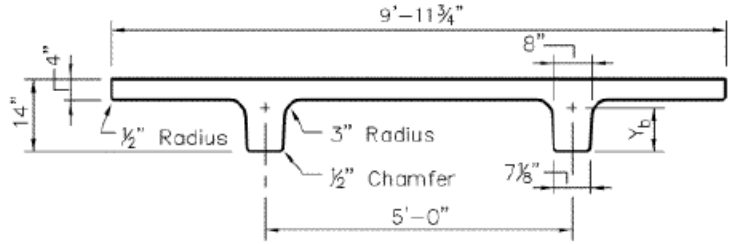
Double Tees + Single Tees : Different Types of Spans





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NOTES:

1. The minimum top flange reinforcement is **WWF 4x4-W2.9/W2.9**, and the maximum safe uniform load on the flange with minimum reinforcement is **180 psf**. Additional flange reinforcement will be required for loads in excess of 180 psf.

Un-topped Thick Flange

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Double Tees + Single Tees : Cost + Maintenance

- Low initial project costs and little maintenance.
- Double and Single Tees are plant-fabricated.
- Provides excellent quality control and speeds up the construction process.
- Precast Double and Single Tees are extremely durable.

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Double Tees + Single Tees : Precedent

- Double and Single Tees are typically seen being used for bridges.
- Since the precast structure allows long spans, it is being used as floor and ceiling components.
- Various stadium and pools use precast structural pieces like double and single tees.

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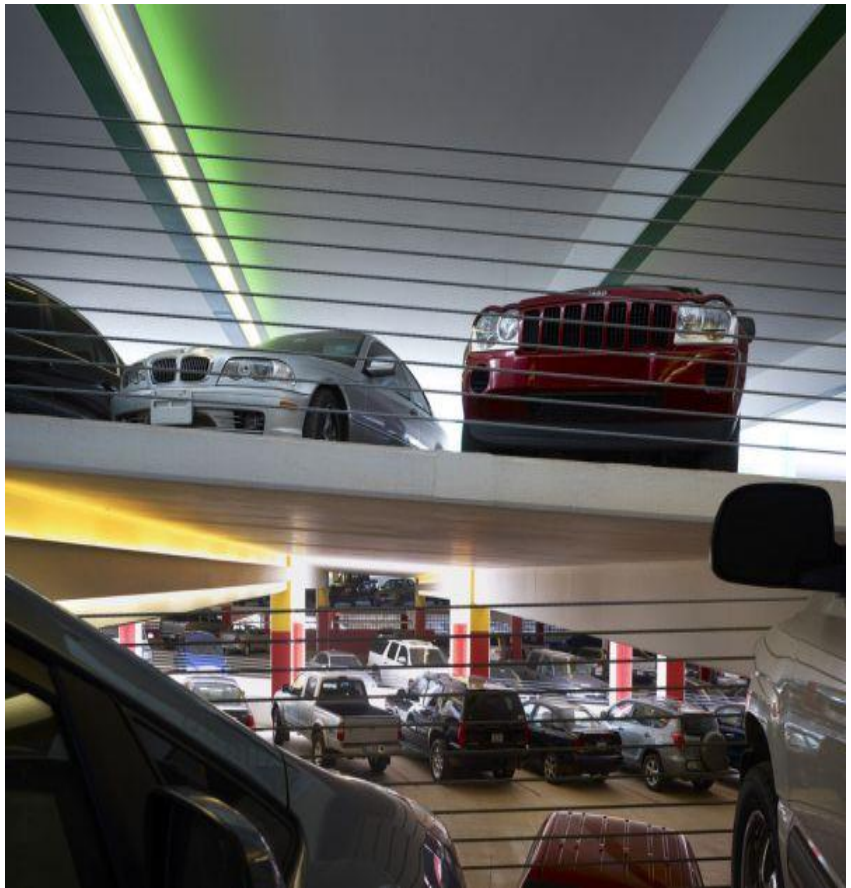
Car Park One

Architects: Elliot + Associates Architects
Location: Oklahoma City, OK
Project Area: 298,907 sq ft.
Project Year: 2008



FINISHES AND CONNECTION DETAILS

SMOOTH/ HARD

BROOMED FINISH

BROOMED SWIRL FINISH

PAINT

DETAILS DETAILS

Fig. 4.5.73 SLAB TO WALL (SW2)

Design
- minimizes eccentricity of load on wall
- axial shortening of slab due to volume change should be considered when designing depth of recess
- pocket dimensions and tee end must be planned so that slab can "swing" into place; pocketed connection should not be used at both ends of slab
- top connection similar to connection SW1 (a) or (b) may be used

Production
- minimum of embedded hardware
- special forming required to allow stems to fit into pockets
- pockets in wall difficult to locate and form, usually do not follow tee taper
- pockets require adequate tolerance
- pocket may telegraph through gray conrete; exterior surface finish, e.g. retarded, sandblasted will help conceal

Erection
- do not drypack pocket around tee stem to allow stem freedom to rotate
- for ease of erection, pockets should not be used at both ends of slab

Variations
- pocket may be at top of panel

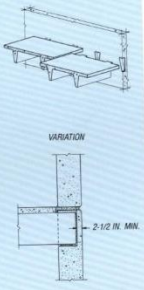


Fig. 4.5.74 SLAB TO WALL (SW3)

Design
- develop a rigid, moment connection
- avoid use of this detail at both ends of slab to prevent excessive restraint
- rotation of wall elements and effects on bracing wall connections and volume changes must be considered
- arrangement of weld plates must allow for welding access
- avoid overhead welding, if possible

Production
- plate jigging is necessary since embed is top-in-form as cast
- steel congestion must be well thought out

Erection
- welding must be completed before setting panel above

Variations
- wall corbel in lieu of angle seat

Fig. 4.5.75 SLAB TO WALL (SW4)

Design
- connection allows movements caused by temperature changes
- positive horizontal force transfer
- connection (c) allows vertical movement by flexing of plate and welds
- connection (d) allows vertical movement through flexibility of double tee flange

Production
- insert must be plumb and true
- washer must be oversize so it does not bind in the slot
- simple

Erection
- quick and easy
- tolerance problems minimized
- do not overtighten bolt in (a)

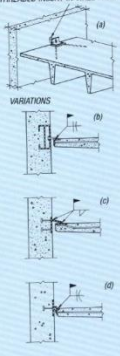


Fig. 4.5.76 SLAB TO WALL (SW5)

Design
- slabs and wall panels should be shaped to create self-forming elements and require a minimum of temporary support and bracing
- crack control is critical to avoid leakage and damage to outside surface of precast concrete panel
- if precast shell and cast-in-place concrete are to act compositely bond ties should be considered — but must be positioned so that reinforcement can be placed
- develops lateral load resisting wall and column sections
- reinforcement that passes across the interface should be adequate to support required forces using shear friction
- must be reinforced to transfer horizontal and vertical shear forces without undue deformations

Production
- placement of panel reinforcing steel must be held to close tolerances to minimize cracking
- good system but precast concrete difficult to cast

Erection
- temporary shoring is often required

Variations
- provide inserts in panel to facilitate forming for cast-in-place concrete

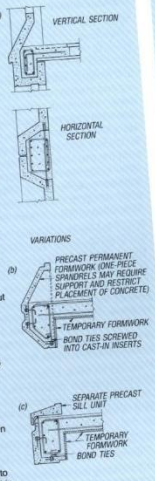


Fig. 4.5.77 WALL TO WALL (WW1)

Design
- continuity through the connections
- connection is concealed and protected
- no connection between walls until splice sleeves or ducts are grouted
- sleeve and sleeve grout are proprietary

Production
- hardware placement is critical
- projecting dowels can cause difficulties in storing and transporting panels if dowels project from bottom of panel

Erection
- may be necessary to heat grout in cold weather
- temporary brace required
- requires a grout crew in addition to setting crew

Variations
- sleeve connector can be placed in either upper or lower panel — upper panel is preferred

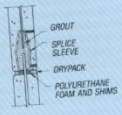


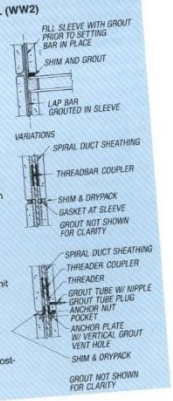
Fig. 4.5.78 WALL TO WALL (WW2)

Design
- can be used to withstand uplift forces
- connection is hidden and protected
- connection is not developed until tensioning is completed (bars are anchored)

Production
- duct and hardware placement in panels is critical
- tolerance on slab length critical
- thin panel outer lip projection subject to damage during handling

Erection
- temporary bracing is required
- drypack, tensioning, grouting sequence may limit erection to one story at a time
- grouting requires care to ensure complete filling

Variations
- bars may or may not be post-tensioned



DETAILS

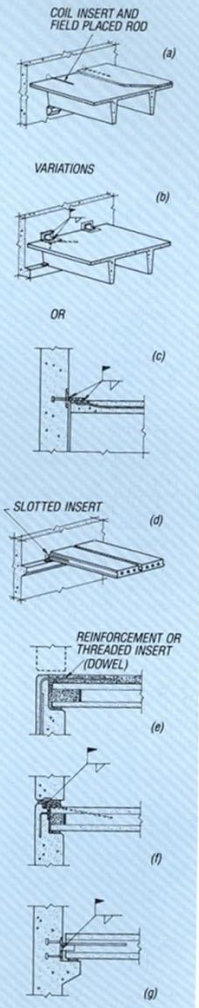
Fig. 4.5.72 **SLAB TO WALL (SW1)**

Design
- welding at bottom of slab is not recommended as excess restraint results
- no moment capacity
- must consider eccentricity of loads
- top connection transfers horizontal shear forces or provides nominal torsion restraint for spandrel

Production
- special forming required for corbel
- corbel may be precast and set in form

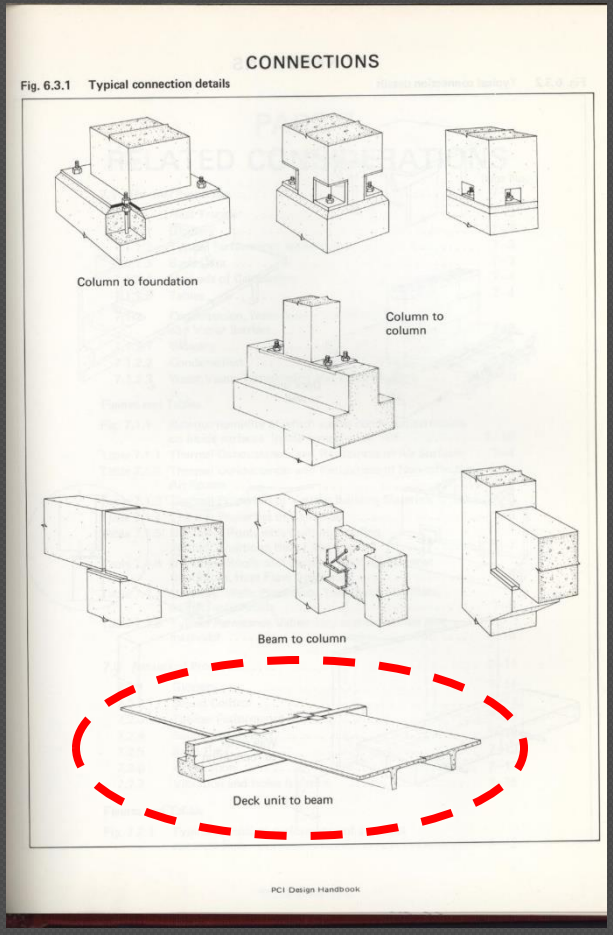
Erection
- quick and easy
- allows adequate tolerances
- temporary bracing may be necessary

Variations
- steel corbel; may use inserts in panel to position angle while welding
- flag shaped plate (g) welded to embedded plate in wall can be used in hollow-core joints
- variation of (d) and (g), dowel may be in topping

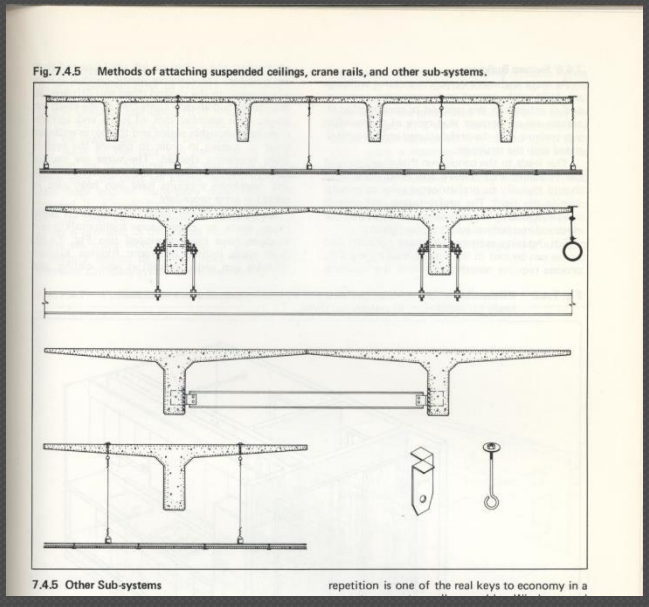


DETAILS

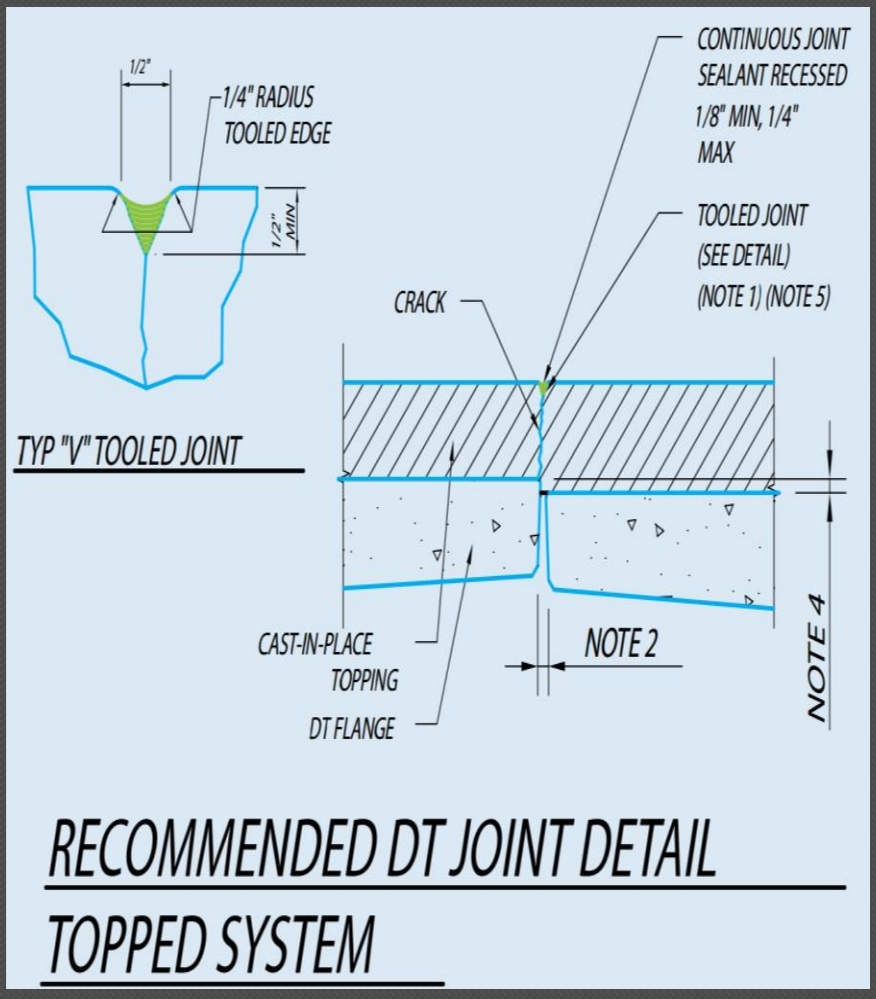
DECK UNIT TO BEAM



ATTACHING SUSPENDED CLNG.



SEALANT JOINT DETAIL



SEALANT JOINT DETAIL