



design/construction solutions

Timber Decks

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Outline

- A few statistics
- Background – types of timber decks
 - Longitudinal elements
 - Transverse elements
- Transverse Timbers on Steel Beams
 - Design basics
 - Hold-downs
 - End dams / end treatments
 - Asphalt overlays
 - Railings
- ASCE Timber Bridge Survey
- Closing Thoughts



Brief Statistics About Popularity of Timber Decks

- 10% of all bridge decks in USA are timber
 - Iowa has 11% of the total
 - 8 other states have at least 4% each of the total
- of those with timber decks
 - 7% are all wood bridges
 - 10% are on thru trusses
 - 78% are on steel beams
- Delaware County, NY (larger than RI)
 - 426 => 270+/- Bridges (>20 ft) & the rest are culverts > 5 ft
 - 14 – all wood
 - 63 have wood decks (15%)

Background – Types of timber decks

- Longitudinal elements
 - Multi-beams without transverse decking
 - Glulam
 - ✓ Panels
 - ✓ Tee-beams (stress-lam)

- Transverse elements
 - Flat-laid planks
 - Nail lam
 - glulam



Longitudinal Elements

Multi-beams without transverse decking

- A by-gone era related to use of trees
- Covered by earth as trail surface
- Subject to relatively rapid deterioration



Longitudinal Elements Cont'd

Glulam Panels as Primary Elements

- Cost-effective for spans – 20 to 30+ ft
- Differential displacement between panels may lead to reflective cracking through wearing surface
- Transverse distribution beam beneath the panels helps, BUT beware swelling of the panels









Oops – leaning rail posts



Oops – darn deck swells, more than the transverse stiffener – solution? – remove horizontal connection?



Longitudinal Elements Cont'd

Glulam Tee-beams (stress-lam) as Primary elements

- Extends the span capability while maintaining all timber







Transverse Elements

Flat-laid heavy planks on closely spaced longitudinal stringers

Occasional use of 2nd flat layer on top

- Provides wear protection of primary transverse decking
- Longitudinal very common – wear protection only
- Diagonally for wear protection and some additional strength





Transverse Elements Cont'd

Flat-laid heavy planks Cont'd

- Common for covered bridges – less so for uncovered structures
- Connections to stringers tend to loosen quickly, leading to a “rattling” deck



Transverse Elements Cont'd

Nail-lam *Vertical (Individual) Planks*

- On-edge placement
 - Using 2-inch nominal thick boards – 4, 6, or 8-inch wide provides varying deck strength vs stringer spacing
- Connectors – spikes of varying size and spacing
- Quite common – many with an overlay, but many without



Transverse Elements Cont'd

Nail-lam *Vertical (Individual) Planks* Cont'd

- Those without an overlay:
 - quickly separate allowing grit and gravel to work down into the deck, leading to accelerated deterioration
 - wear of the top surface can occur quite rapidly
 - relatively short life spans – definitely less than 20 years – often less than 10



JUN 2 2009







Transverse Elements Cont'd

Transverse – Nail-lam or Glulam *Panels* on
Longitudinal Stringers

- Faster erection
- Differential displacement between panels leads to reflective cracking through wearing surface



03/14/2009



Transverse – Nail-lam *Timbers*

This type of timber deck is the primary focus of this discussion:

- Based on experience of Delaware County, NY (large rural area) – my involvement somewhat dated
- In combination with asphalt wearing surface – very cost competitive and serves well
- This type of transverse deck won out over use of heavy metal pan decks for several reasons (premature corrosion and failure of studs to beams – requires welding of galvanized metal – environmental issue)



**The following details and some photos
provided graciously by the Delaware
County Dept of Public Works**



Transverse – Nail-lam *Timbers*

Transverse – Nail-lam *Timbers*

- On-edge placement – often 6x8 (readily available)
- Constructed on-site with individual elements or with pre-fabricated panels







Transverse – Nail-lam *Timbers*

- Heavy timbers reduce number of pieces to handle
- Pre-fabricated panels now preferred
- Typically restricted to bridges on “Town-owned” Roads with less traffic, but occasionally used on County Roads
- Can be placed year around (asphalt in summer)

CHIA Transv. – Nail-lam Timber *Design*

Design basics:

- AASHTO – LRFD vs ASD ?
- Design span?
 - Skews okay up to ? degrees (from perpendicular to beams)
- Dead load?
- Distribution width for wheel?
- Material properties? (#2 SP avail.)

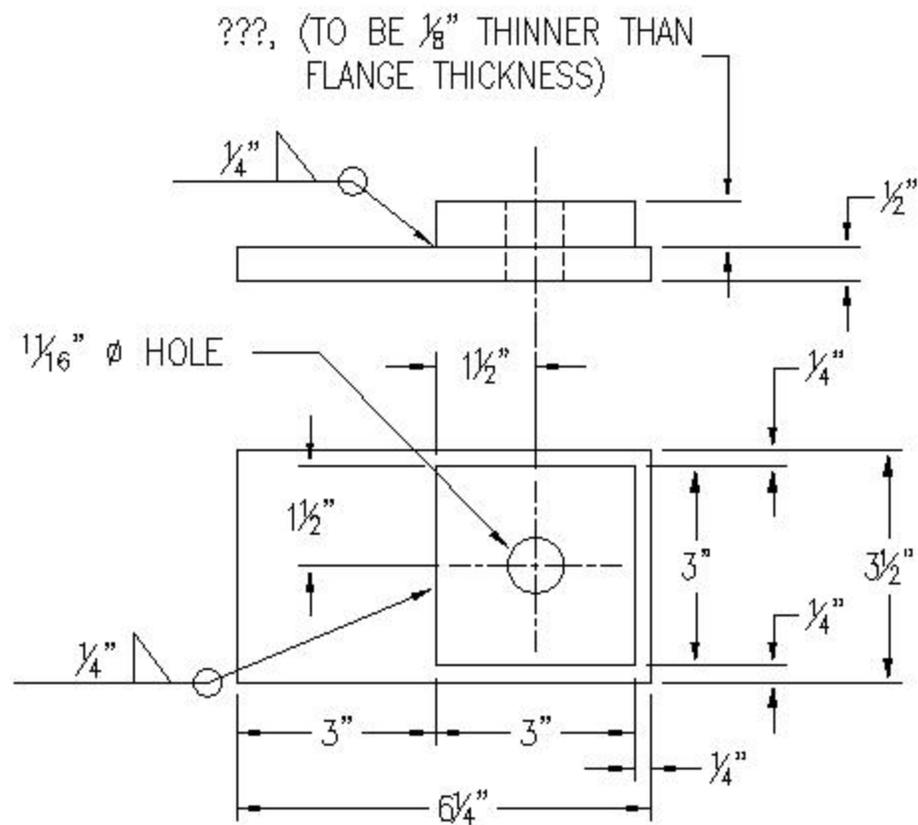
CHIA Transv. – Nail-lam Timber *Details*

Fabrication and installation

- Connectors – larger spikes inserted in predrilled holes – uses air powered drivers
- Separation of deck from flange
- Hold-downs –
 - Embedded plates
 - Heavy plate below and thru-bolt



NO!!



DECK CLIP DETAIL

SCALE: 1" = 0'-3"



Good

CHIA Transv. – Nail-lam Timber *Details*

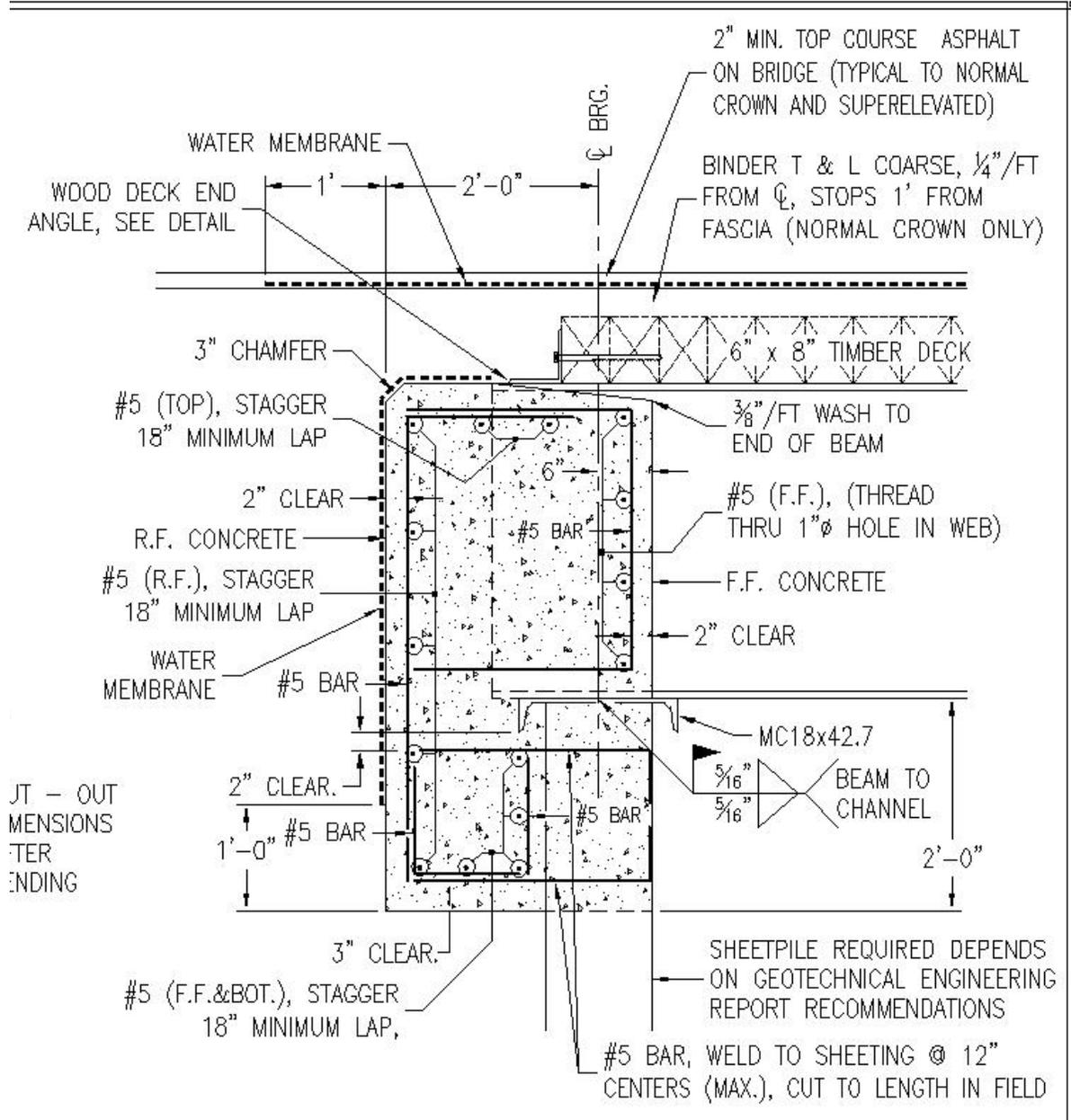
End Dams

- There are some good details and some
- Some involve asphalt directly against the timber
- Some have angles welded to the top of stringer, against which the asphalt is placed



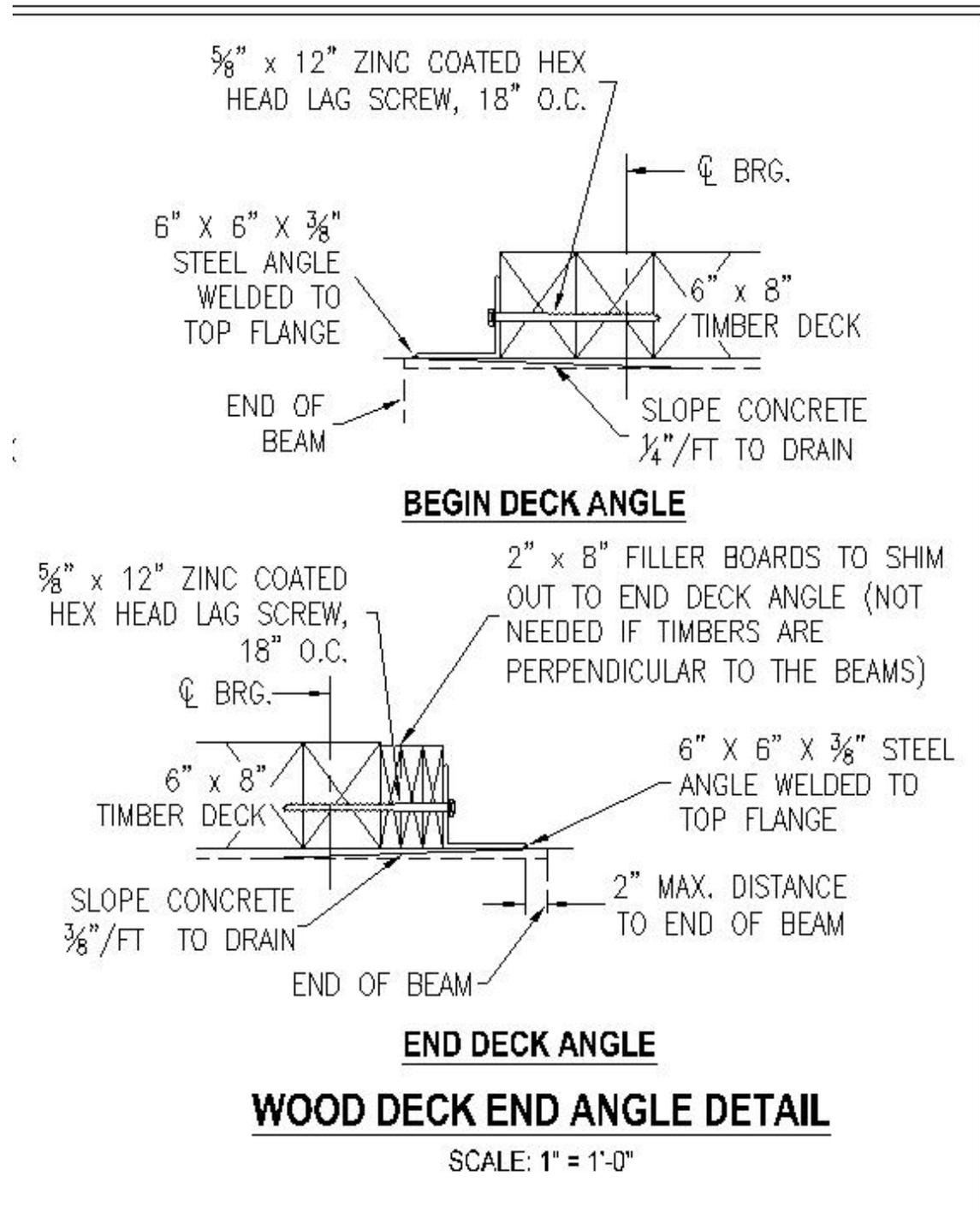


04/23/2007



ABUTMENT BACKWALL SECTION

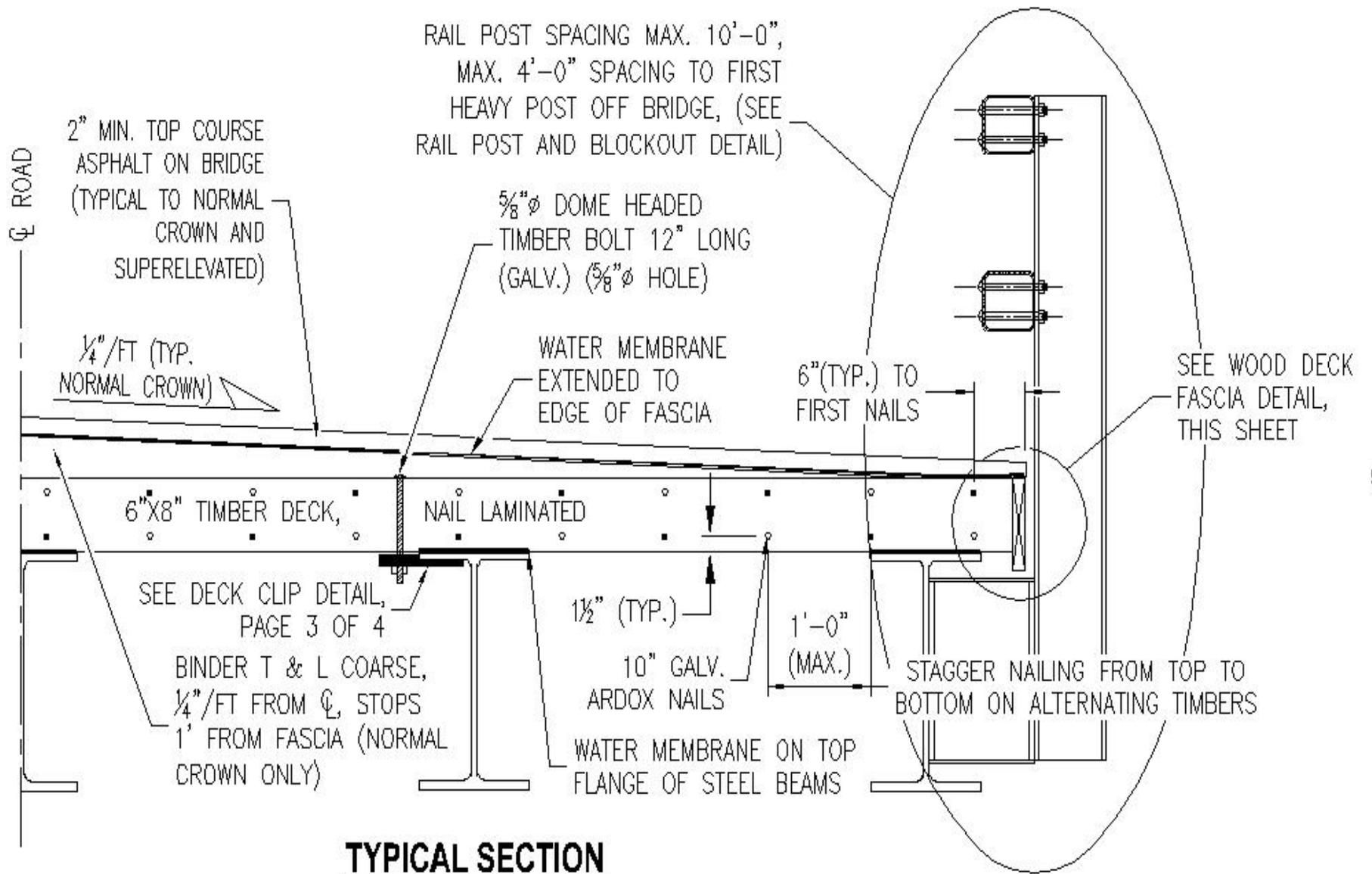
SCALE: 3/4" = 1'-0"



CHIA Transv. – Nail-lam Timber *Details*

Asphalt

- Truing & Leveling course directly on timber – top surface has final cross slope
- Waterproofing Membrane
- Top Course
- An update is provided in a few slides



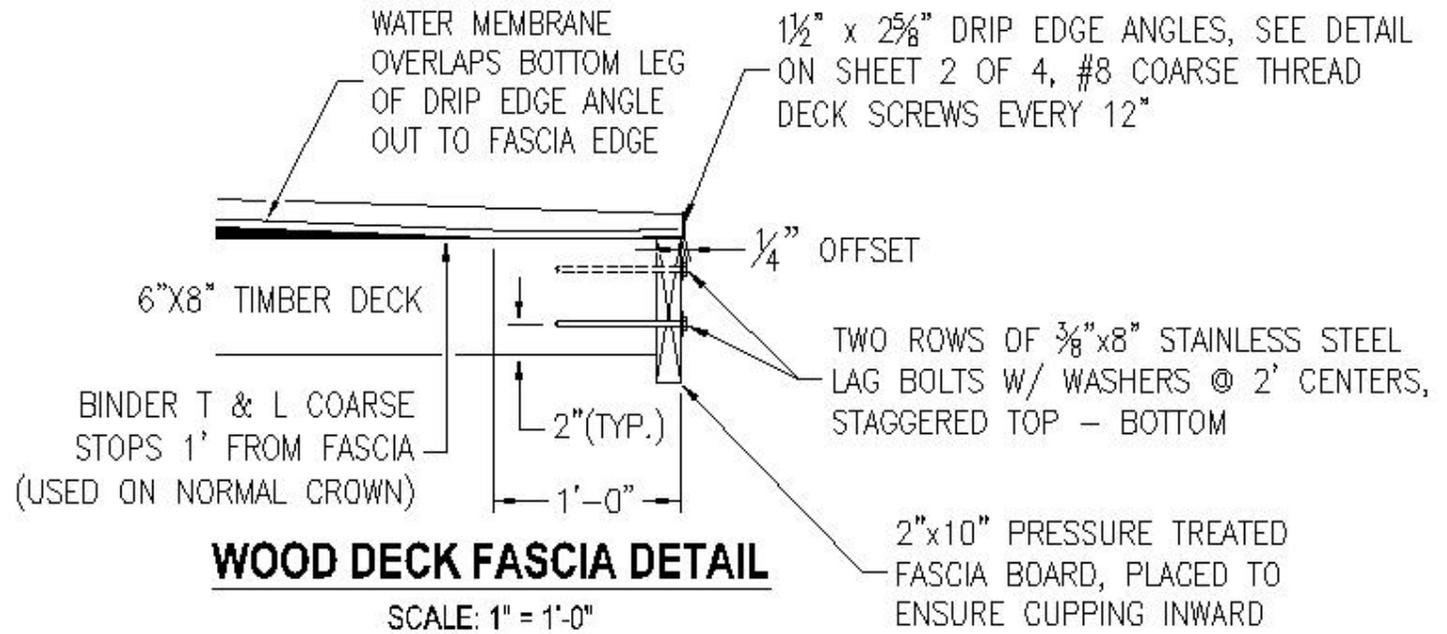
TYPICAL SECTION

SCALE: 3/4" = 1'-0"

CHIA Transv. – Nail-lam Timber *Details*

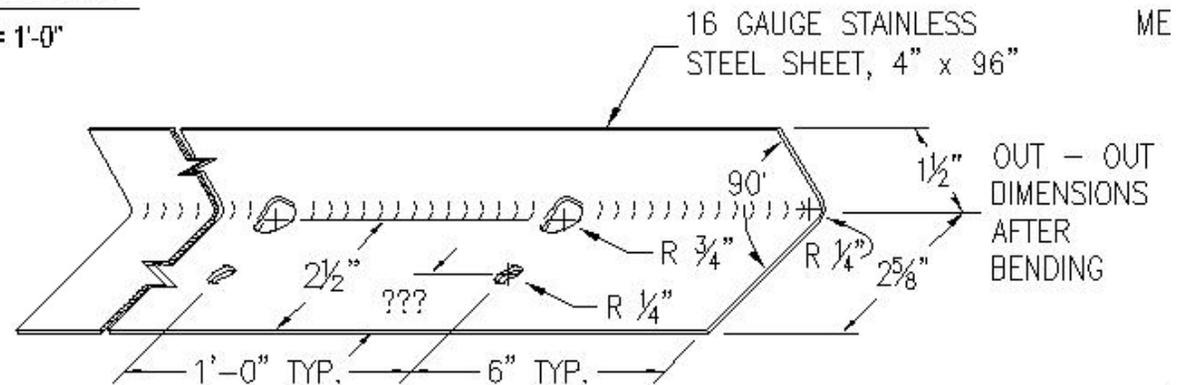
Edge Treatment

- Fascia galvanized light-weight angle on top of deck with drain holes – acts as dam for asphalt
- Fascia treated plank – deeper than timber to act as drip edge



HRAM DETAIL

SCALE: 1" = 1'-0"



???

IN.

NOT TO EXCEED 25'0"

7

CHIA Transv. – Nail-lam Timber *Details*



Asphalt – problem issues – if you leave a strip at the outside – guess what?

Premature deterioration!

CHIA Transv. – Nail-lam Timber *Details*

Asphalt - UPDATE

- The USDA Forest Service at Missoula published “Asphalt Paving of Treated Timber Bridge Decks”, Nov 2003 and revised Nov 2012
- This provides an excellent discussion of timber decks, not just limited to paving

CHIA Transv. – Nail-lam Timber *Details*

Asphalt – UPDATE

– Recommendations:

- Delay paving (30-45 days) to allow preservatives to evaporate / be worn by traffic
- Min 1.5 inch crowned initial asphalt over tack coat
- Membrane
- Min 1.5 inch top coat
- Gee – Delaware County doing good!

CHIA Transv. – Nail-lam Timber *Details*

Railing Posts

- Some connect base plates directly on top of timber deck and through bolt
 - individual bottom plate,
 - continuous channel, or
 - even individual timber blocks (?!)



Base plates directly on top of timber deck and through bolt with individual bottom plate – limited engagement of deck planks





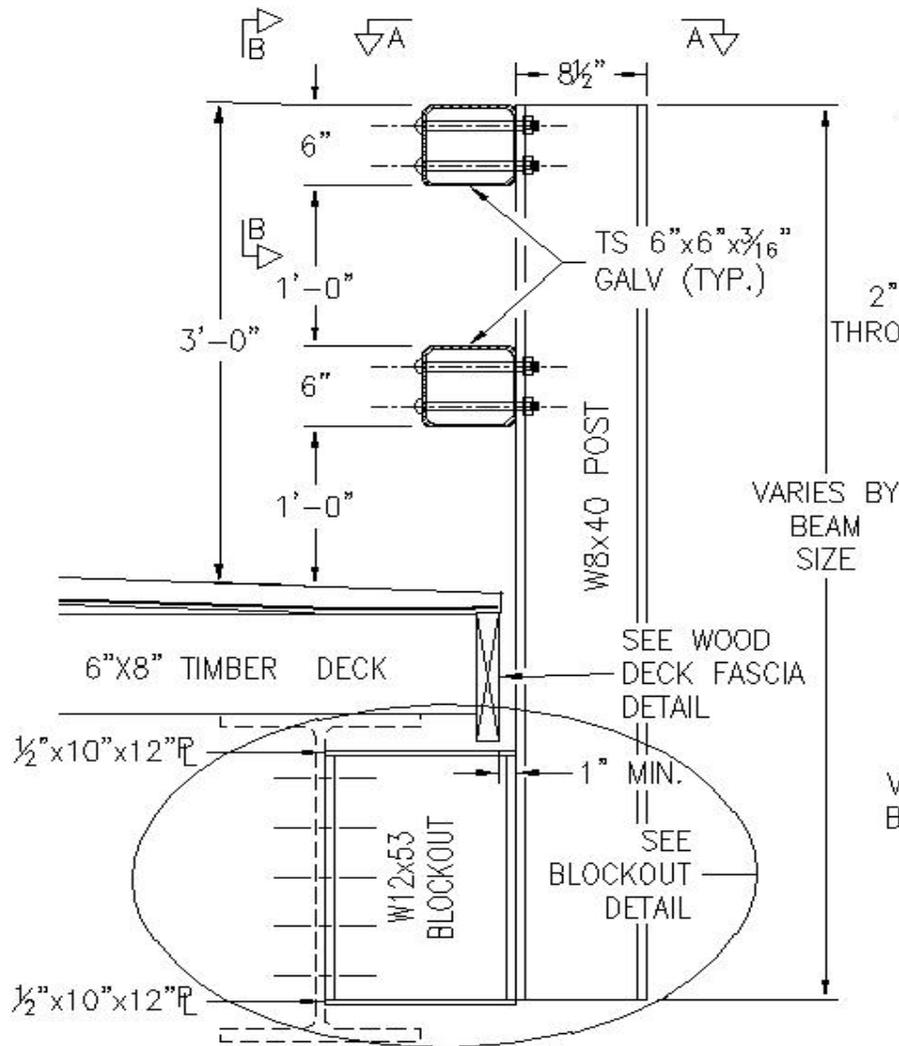
Base plates directly on top of timber deck and through bolt with continuous channel on bottom – good engagement of deck



CHIA Transv. – Nail-lam Timber *Details*

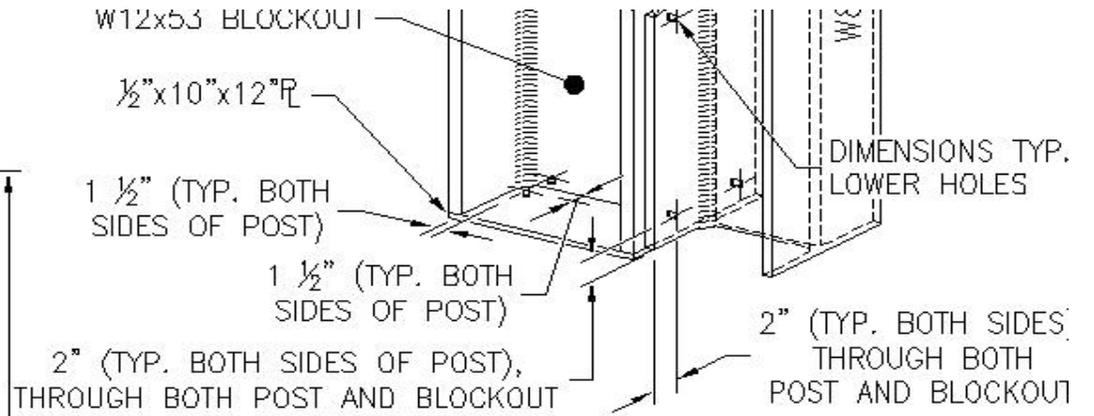
Railing Posts

- DCDPW prefers steel block-outs and connection directly to the exterior steel beam (with back-up diaphragm)
- The separation of posts from the deck avoids many hassles
- Posts can be prefabricated (and galvanized)



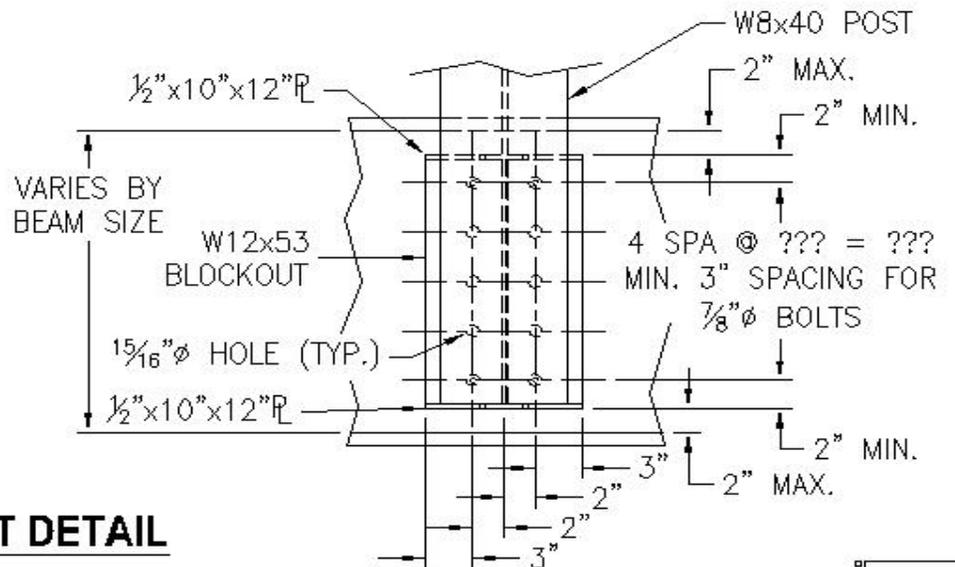
RAIL POST AND BLOCKOUT DETAIL

SCALE: 1" = 1'-0"

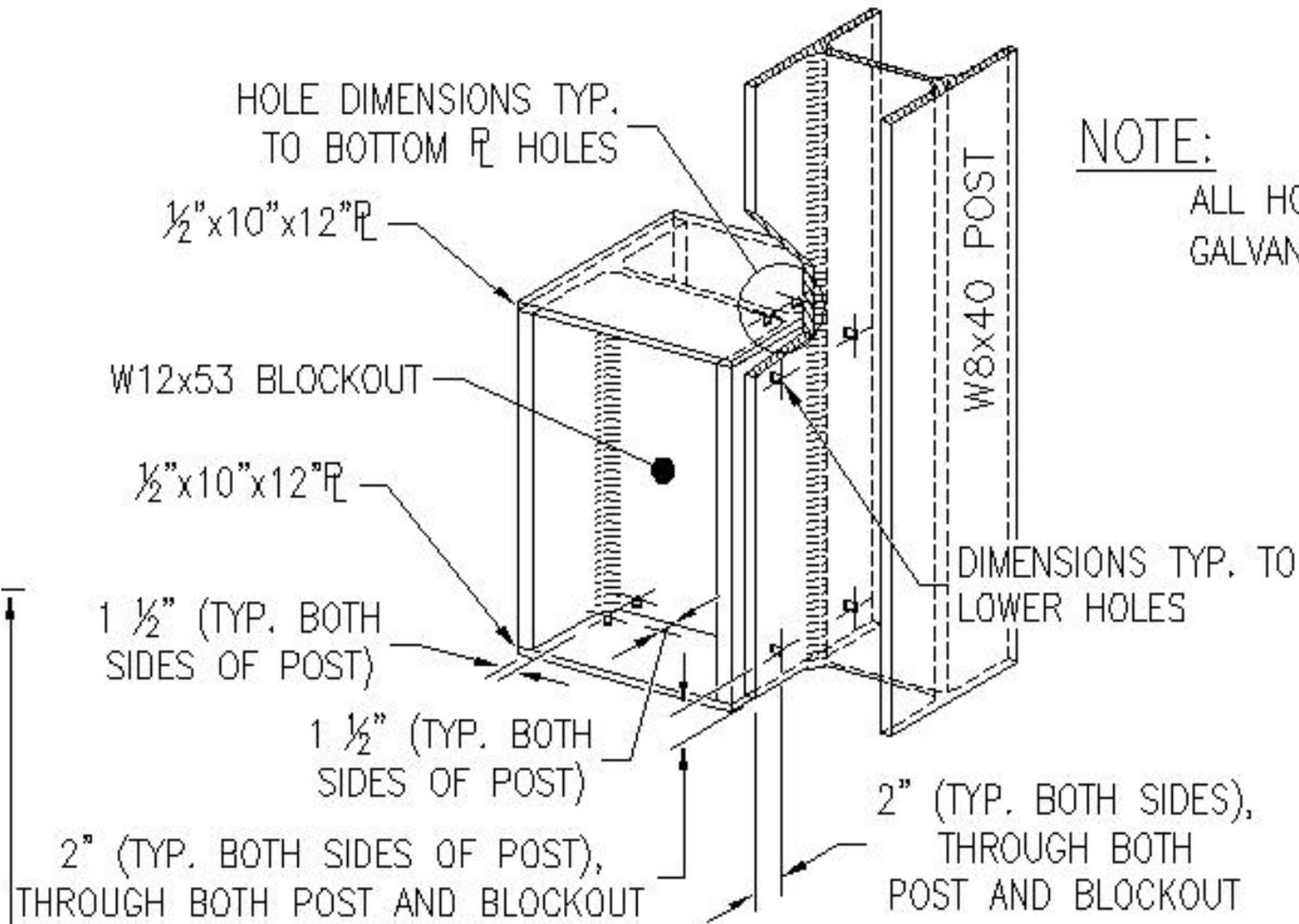


**BLOCKOUT POST HOLES
REQUIRED FOR GALVANIZING**

SCALE: 1" = 1'-0"



2
1
REVISION



NOTE:
 ALL HOLES REQUIRED FOR GALVANIZING ARE $\frac{3}{8}$ " ϕ

$\frac{7}{8}$ " ϕ HOLE AND $\frac{3}{4}$ " CARRIAGE BOLT W/ HEX NUT AN LOCK WASHER (TYP)

BLOCKOUT POST HOLES
REQUIRED FOR GALVANIZING

SCALE: 1" = 1'-0"

DES BY
 JAM
 7F





What about those preservatives?

- Commonly used:
 - Water-based:
 - ✓ CCA – chromated copper arsenate – the most common – the “green stuff”
 - ✓ ACZA – ammoniacal copper zinc arsenate – requires galv connectors
 - Oil-based:
 - ✓ Creosote – yes, really! – oldest, but..
 - ✓ Pentachlorophenol – since 1940s
 - ✓ Copper Naphthenate – also since 40s

CHIA ASCE Timber Bridge Survey

- ASCE Timber Bridge Committee – national survey
 - Aimed primarily at timber *superstructures* and not prepared to separate out information only about timber *decks*
 - Some interesting tidbits from the survey:
 - ✓ Wearing surface
 - Asphalt applied to only 50%
 - Timber running planks on 30%
 - Gravel used on remaining (really!)



ASCE Timber Bridge Survey

- State respondents – “pros”
 - Low first cost
 - Easy construction
 - Easy repair
 - Lightweight
 - Easier in remote areas
 - Renewable material
 - Resistant to deicing chemicals
 - Long-lasting and durable



ASCE Timber Bridge Survey

- State respondents – “cons”
 - Short life / frequent maintenance
 - Limited capacity / span
 - Subject to rot – early demise
 - Susceptible to fire
 - Susceptible to deicing chemicals
 - Difficult to inspect
 - Wearing surface problems
 - Preservative chemical issues



ASCE Timber Bridge Survey

- So what shall we believe?
 - Depends on perspective
 - Depends on preferences
 - Depends on precedents



Timber Decks on Steel Beams – Closing Thoughts

- Positives:
 - Timber remains popular, at least for local bridges
 - Involves less equipment / skilled labor
 - Faster construction
 - Timber deck about half of the cost of concrete deck (but must consider beam costs too...)
 - Can be built year around
 - Attention to details extends life



Timber Decks on Steel Beams – Closing Thoughts Continued

- Negatives:
 - Limited span – requires closer stringers
 - Non-composite
 - Potential reflective cracking in asphalt



Acknowledgements

- Photos from many sources
 - Delaware County DPW
 - Bridge inspection photos from various people and locations



Potential Answers:

1. Name Two Types of Transverse Timber Decks?

–*Nail-lam planks,*

–*Glulam panels, or*

–*Heavy timbers*



Potential Answers:

2. Advantages of Timber Decks?

–Place year around

–Faster than concrete



Potential Answers:

3. Disadvantages of Timber Decks?

–*No composite action*

–*Stringer spacing limitation*

–*Issue of reflective cracking
in asphalt*



Hey – wait a minute!

What about that reflective cracking in asphalt??!!

DCDPW tried plywood over the joints with deck screws. Then membrane and asphalt. It seemed to help some...

But their current practice with prefab panels of heavy timbers with strong anchors has not encountered reflective cracking.

Recent testing at Iowa State with FPL – no success with plywood – now focused on asphalt mix.