BRIDGE PRESERVATION "ACHIEVING A FULL SERVICE LIFE"

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California Department of Transportation

Western Bridge Preservation Partnership Meeting

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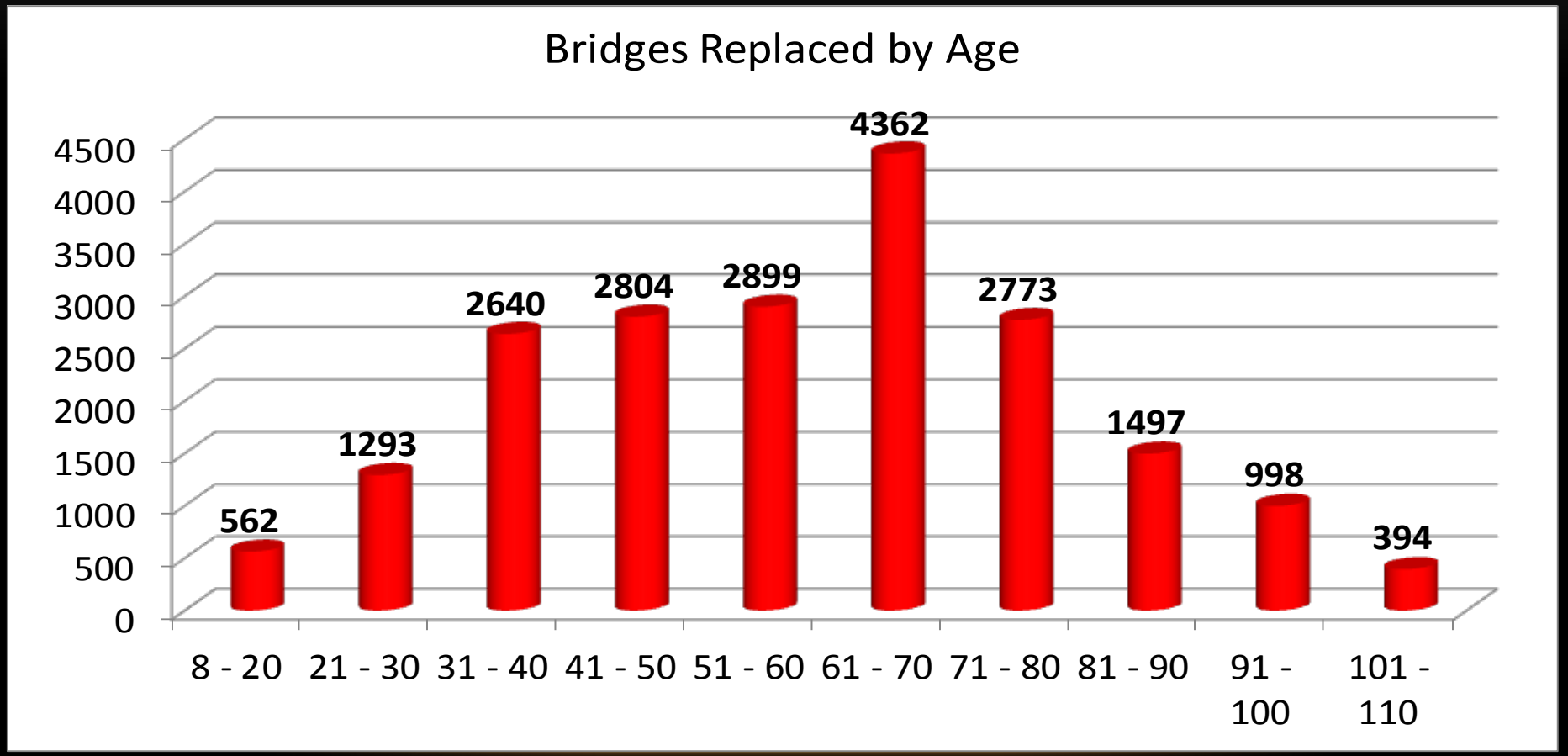
PRESERVATION SERVICE LIFE

Bridge Preservation focuses on material selection, design, construction and preservation techniques to extend the service life of bridge components and bridge itself.

- What is a full service life for a bridge?
- What causes bridges to no longer provide service?
- What strategies can extend the service life?

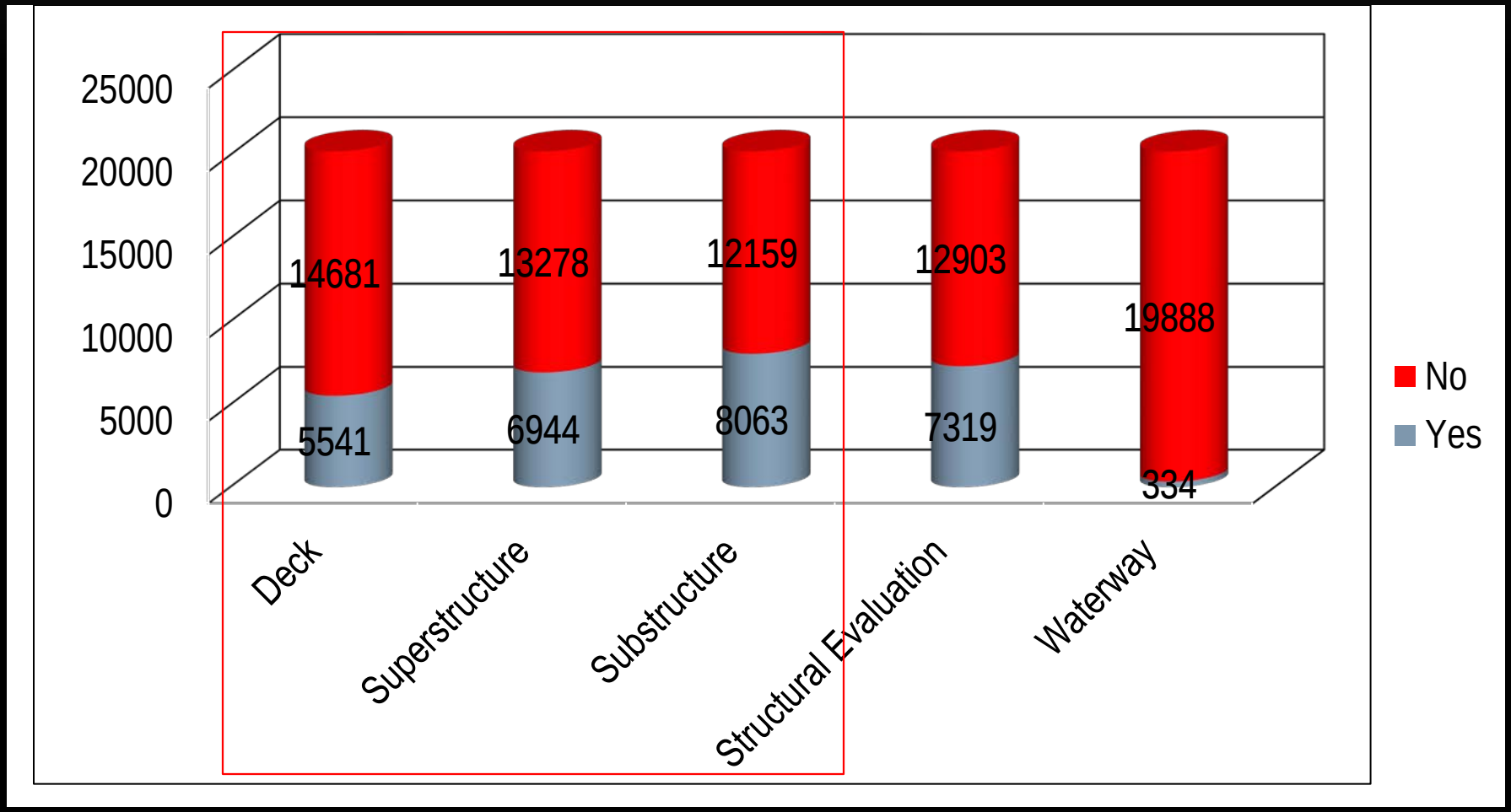
TRB BRIDGE PRESERVATION NATIONAL STUDY LIFESPAN OF BRIDGES IN THE U.S.



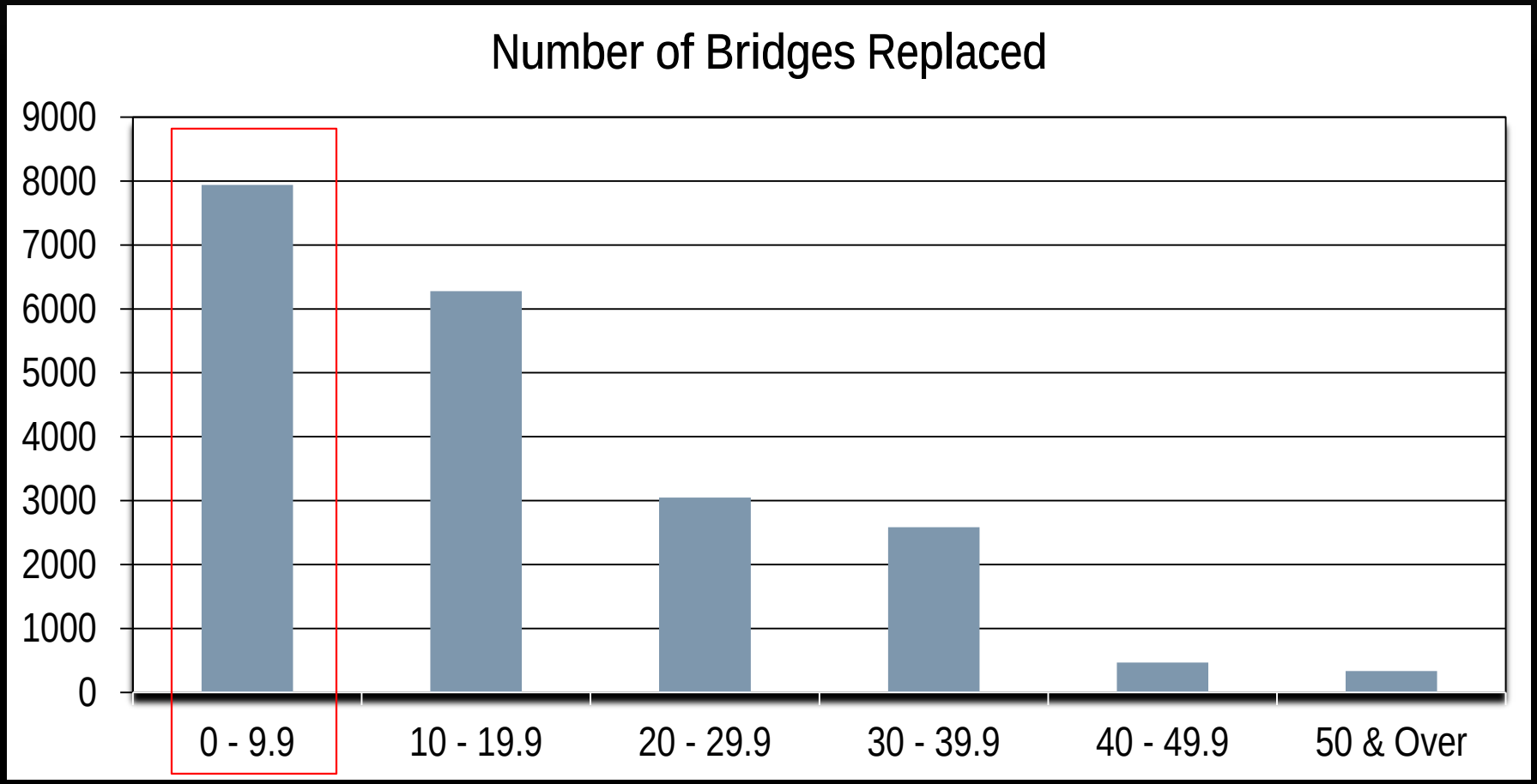
72% off all bridges are replaced in 70 years or less

TRB BRIDGE PRESERVATION NATIONAL STUDY CONDITION DEFICIENCY OF REPLACED BRIDGES

(STRUCTURALLY DEFICIENT RATINGS)

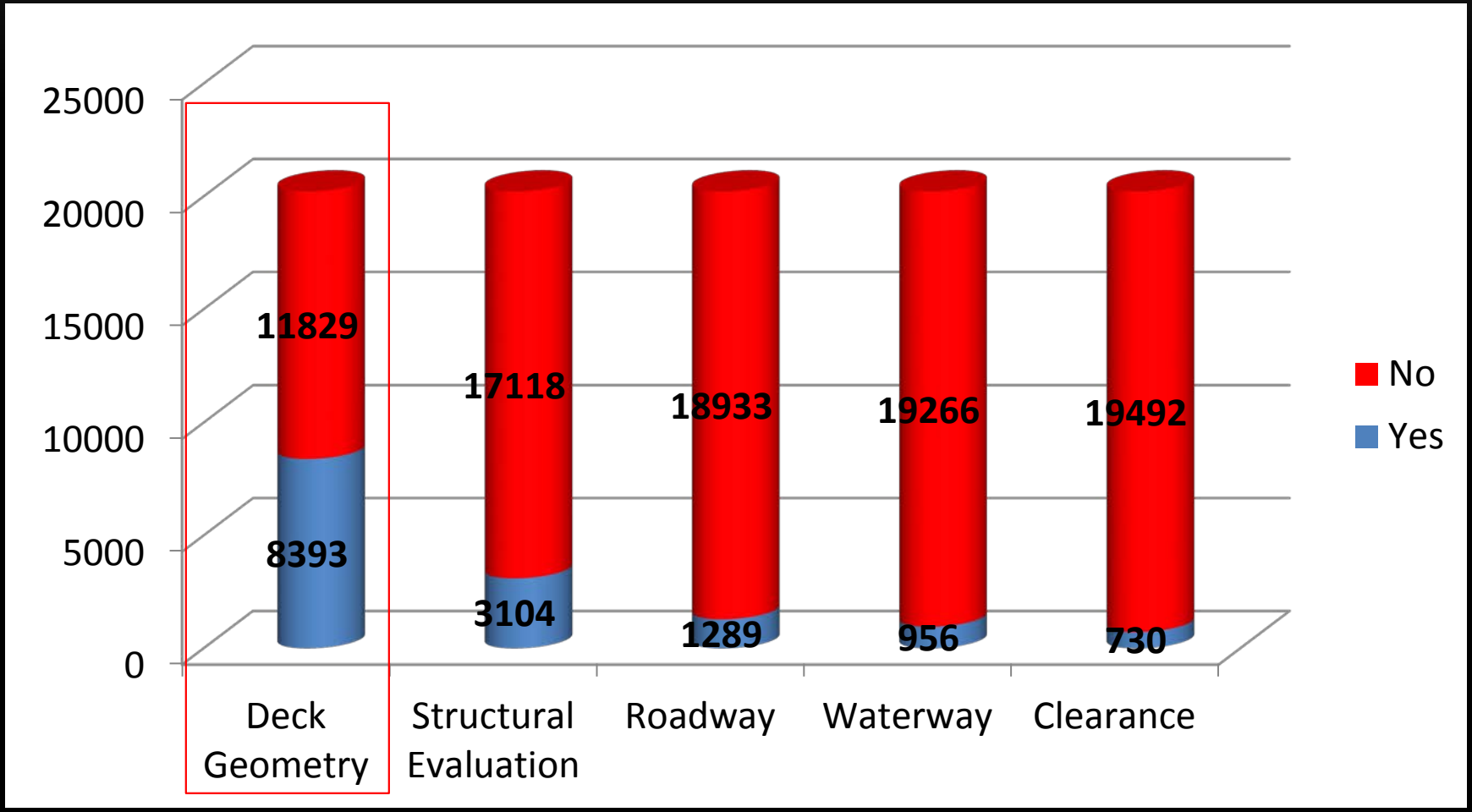


TRB BRIDGE PRESERVATION NATIONAL STUDY
LOAD CAPACITY OF REPLACED BRIDGES
(INVENTORY RATING IN METRIC TONS)



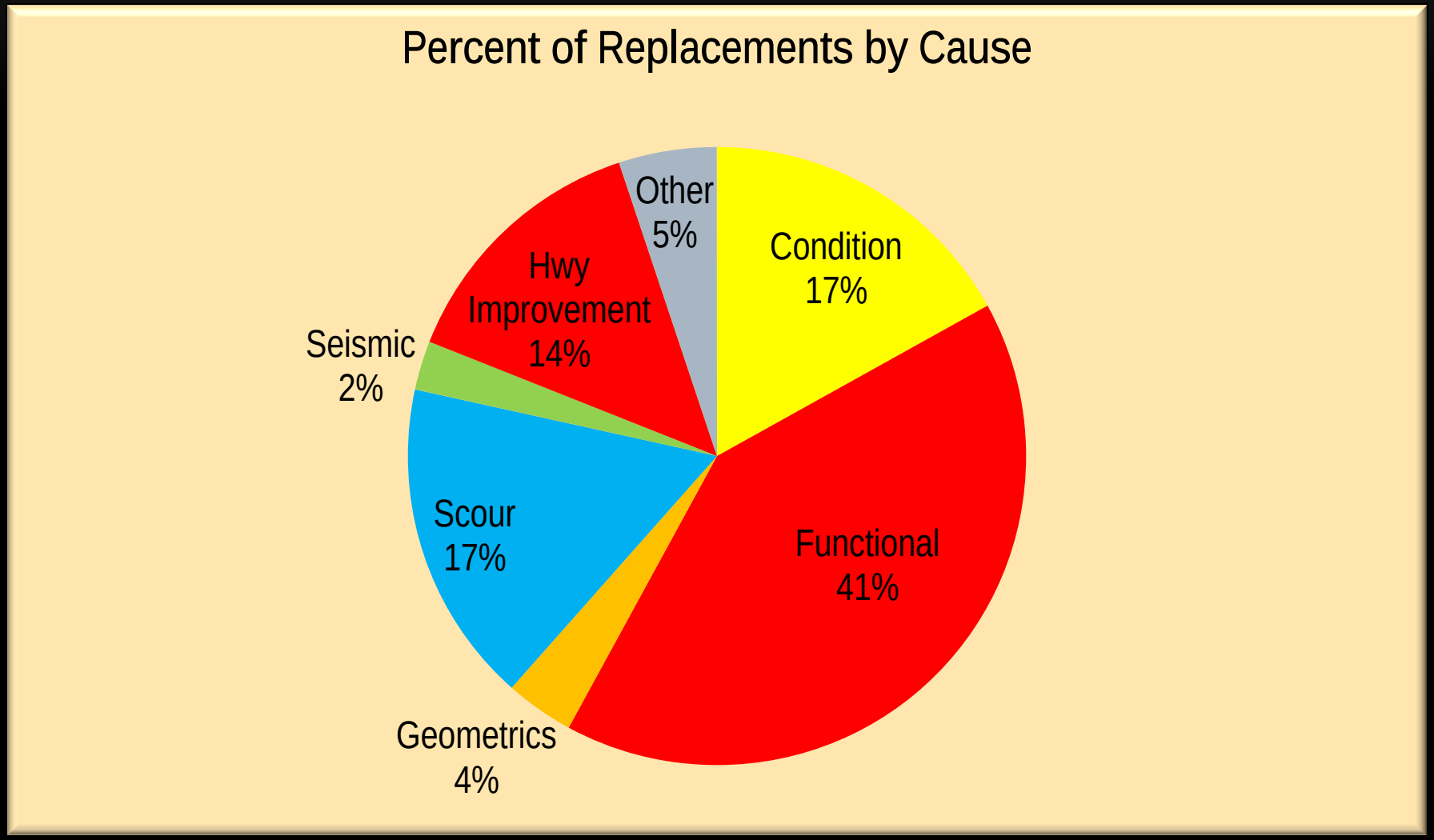
More than 33% of bridges replaced have very low load capacities.

FUNCTIONALLY CHARACTERISTICS OF REPLACED BRIDGE IN THE UNITED STATES



Approximately 41% of bridges replaced have width or clearance limitations

CALIFORNIA STUDY
CAUSES OF BRIDGE REPLACEMENTS



CALIFORNIA FINDINGS

- Average age at replacement = 52.2 Years
  - Oldest – 92 Years Youngest – 21 Years
- At Replacement
  - SD = 61 (32%) FO = 59 (31%) Neither = 68 (36%)
- Average length increase = - 0.6 feet
- Average width increase = 10.2 feet
- Functional needs driving many bridge replacements

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (BRIDGE DECK PERFORMANCE)

- Control Bridge Deck Reinforcing Corrosion
  - Use proper curing strategies that minimize cracking during the curing process.
  - Standardize the use of fibers in all new concrete.
  - Design decks with non-monolithic overlays that are placed after deck cure and prior to opening.
  - Evaluate corrosion resistant reinforcing in harsh climate areas.
  - Seal or overlay decks timely when cracks develop.

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE
(DECK CRACKING CASE STUDY)

DEPARTMENT OF TRANSPORTATION
Structure Maintenance & Investigations

Caltrans

Bridge Inspection Report

Bridge Number
Facility Carried
Location
City
Inspection Date
Inspection Type
Routine [X] FC [ ]

STRUCTURE NAME INGRAM SLOUGH

CONSTRUCTION INFORMATION

Year Built	2001	Skew (degrees)	17
Year Widened	N/A	No of Joints	2
Length (m)	42	No of Hinges	0

Structure Description Four span continuous reinforced concrete slab on
abutments and piles (15 per bent) All on piles

Span Configuration 1 @ 9.0 m 2 @ 12.0 m 1 @ 9.0 m

INSPECTION COMMENTARY

CONDITION OF STRUCTURE

DECK AND APPROACHES

As previously reported, there are transverse cracks of moderate
in the approach slabs.

The pourable joint seals exhibit early distress, however, appea
intended at this time. The Abutment 5 joint seal exhibits adhesion failures along 3.0-m
of its length.

The deck was treated with methacrylate in 2009 to treat the moderate to heavy longitudinal, transverse and pattern cracks throughout the deck surface. There are several areas with large aggregate popouts.

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (GEOMETRICS AND FUNCTION)

- Bridges should be adaptable to future needs
  - Design substructures for future widening
  - Will a future widening still leave enough vertical clearance?
  - Rail safety standards require periodic rail upgrades. Design deck overhangs accordingly.
  - Can the load capacity be increased if needed?

ADAPTABLE BRIDGE GEOMETRICS
(GEOMETRICS CASE STUDY)

Progressive Designs Can Accommodate Future Widening Needs

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (STEEL FATIGUE MITIGATION)

- Minimize Steel Fatigue – it's a big culprit limiting the service life of steel superstructure bridges.
  - Increase the girder depth and web thickness beyond the minimum for design especially on skews.
  - Limiting deflection will reduce fatigue potential.
  - Bracing details are critical to controlling fatigue cracking.
  - Balance stiffness on both sides of the girder.
  - Tightly enforce welding specifications.

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE
(STEEL FATIGUE CASE STUDIES)

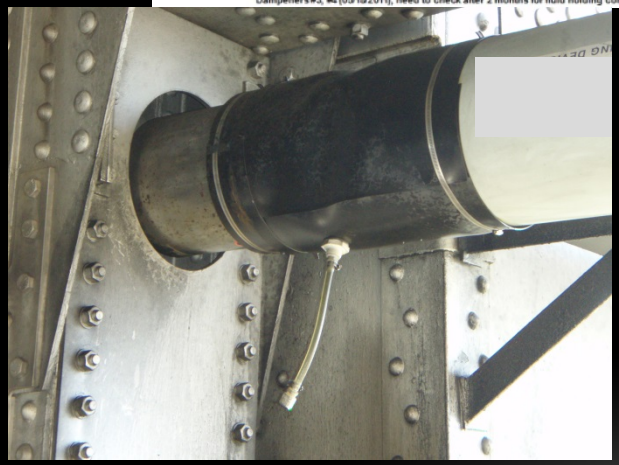
STRATEGIES TO ACHIEVE A FULL SERVICE LIFE
(STEEL FATIGUE CASE STUDIES)

Cracked Gusset

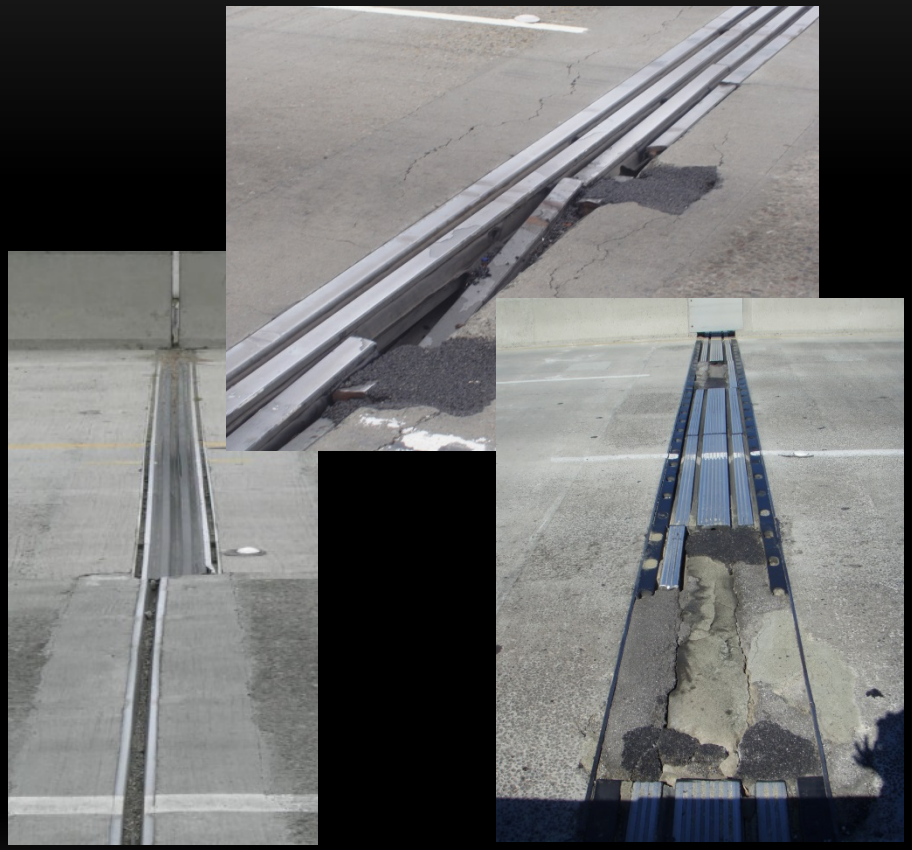
STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (CONDITION)

- Don’t over economize on design
- Saving a few bucks on the initial construction cost may result in longer life cycle costs for the bridge.
  - Products such as lightweight concrete, aluminum joint seal assemblies and viscous dampers have a history of underperformance.
  - Think about how to widen a bridge when designing it. Is it possible? If not service life is probably limited.

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (PRODUCT SELECTION)



Leaky Viscous Dampers

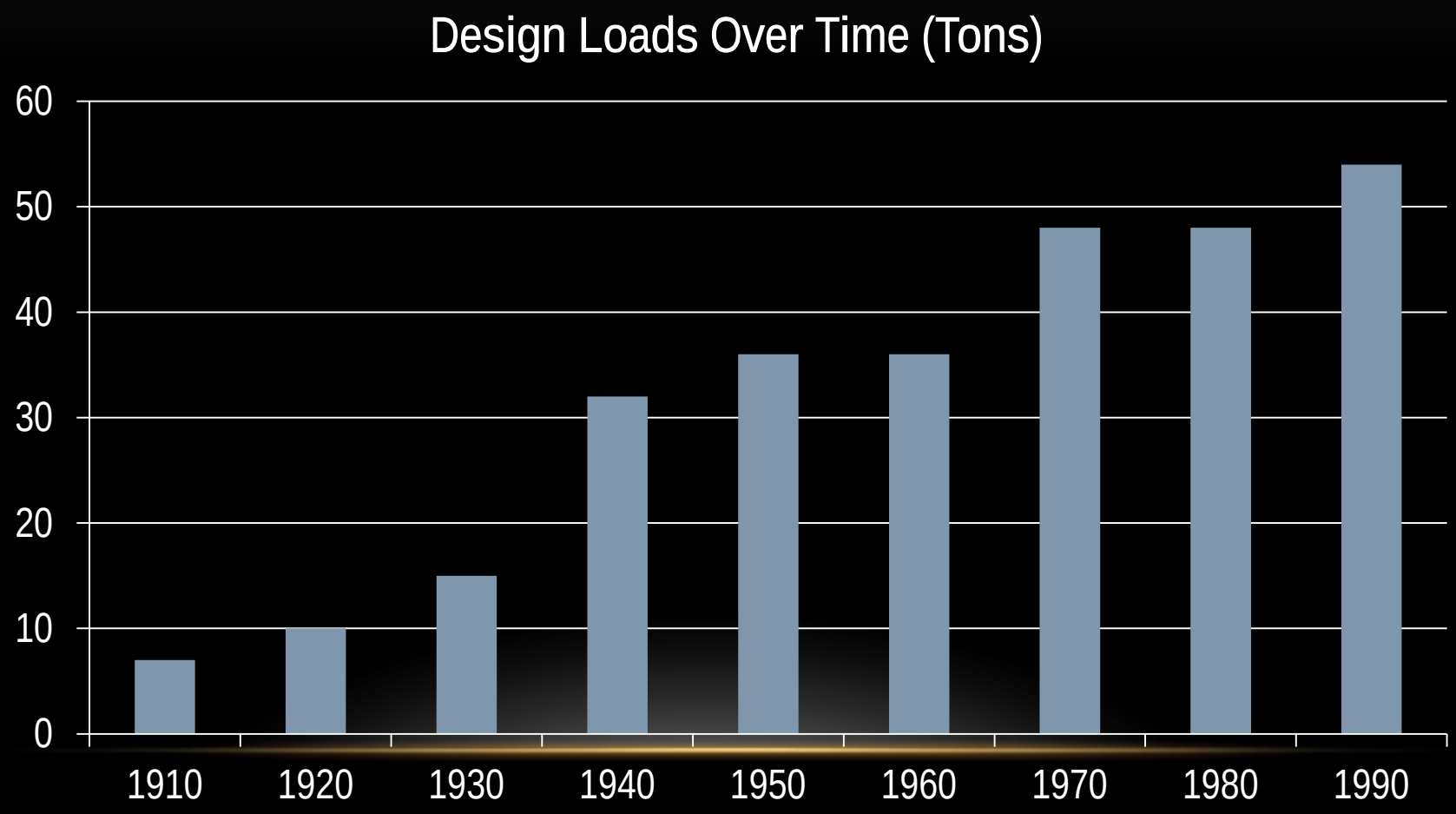


Aluminum Assemblies

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE
(POOR LIFE CYCLE COST CASE STUDIES)

Lightweight deck paired with light girder design - Requires new deck and strengthening for load

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (LOAD CAPACITY)



STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (LOAD CAPACITY)

1920's loading versus
todays permit truck loading

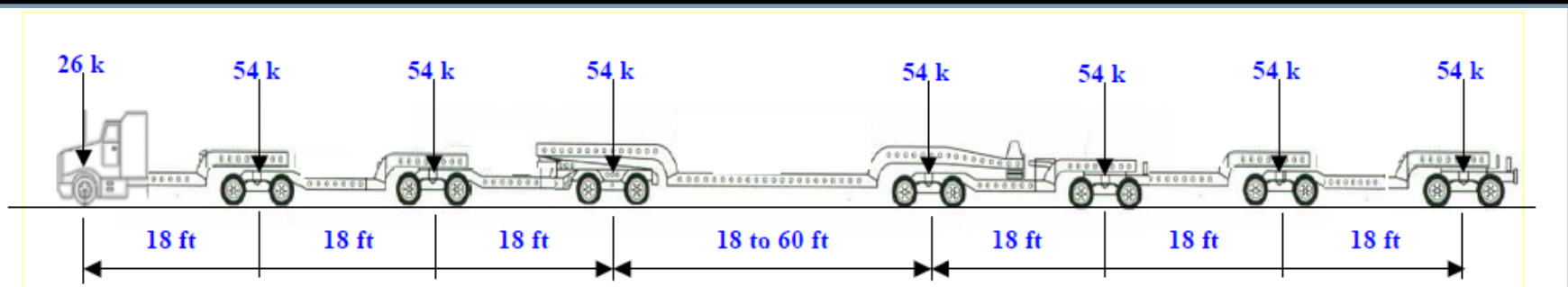


Figure 3.6.1.8.1-1 California P15 truck

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE (PLANNING FOR INCREASED LOADING)

- Expect that loads will increase over time.
- Tighten up shear stirrup spacing beyond the 1/4pts and hold uniform spacing whenever possible.
- Do not use temperature steel to resist vehicular design live loads.
- Eliminate and/or reduce bar cut offs.
- Increase deck thickness. Life cycle cost is worth it.
- Design new bridges for future strengthening. If you don’t, service life is probably limited.

INSPECTION AND MAINTENANCE ACCESS
(GOOD ACCESS EXAMPLES)

Box Girder Access

Fracture Critical Member Catwalk Inspection Access

INSPECTION AND MAINTENANCE ACCESS
(ROOM FOR IMPROVEMENT)

No access through sound wall

Viscous damper fill port blocked

Lack of Internal Lighting

STRATEGIES TO ACHIEVE A FULL SERVICE LIFE

- Replacements are driven by conditional, functional and operational needs.
- Consider the life cycle cost when making design decisions.
- Use quality products that have a history of performance
- Plan for future widening's and rail replacements
- Use strategies presented for future load capacity
- Maintain high quality welding and concrete curing.
- Provide inspection and maintenance access

Thank You