Presentation of the Through Running Operations Analysis to Accommodate a Potential Future East Bay Connection

September 17, 2021

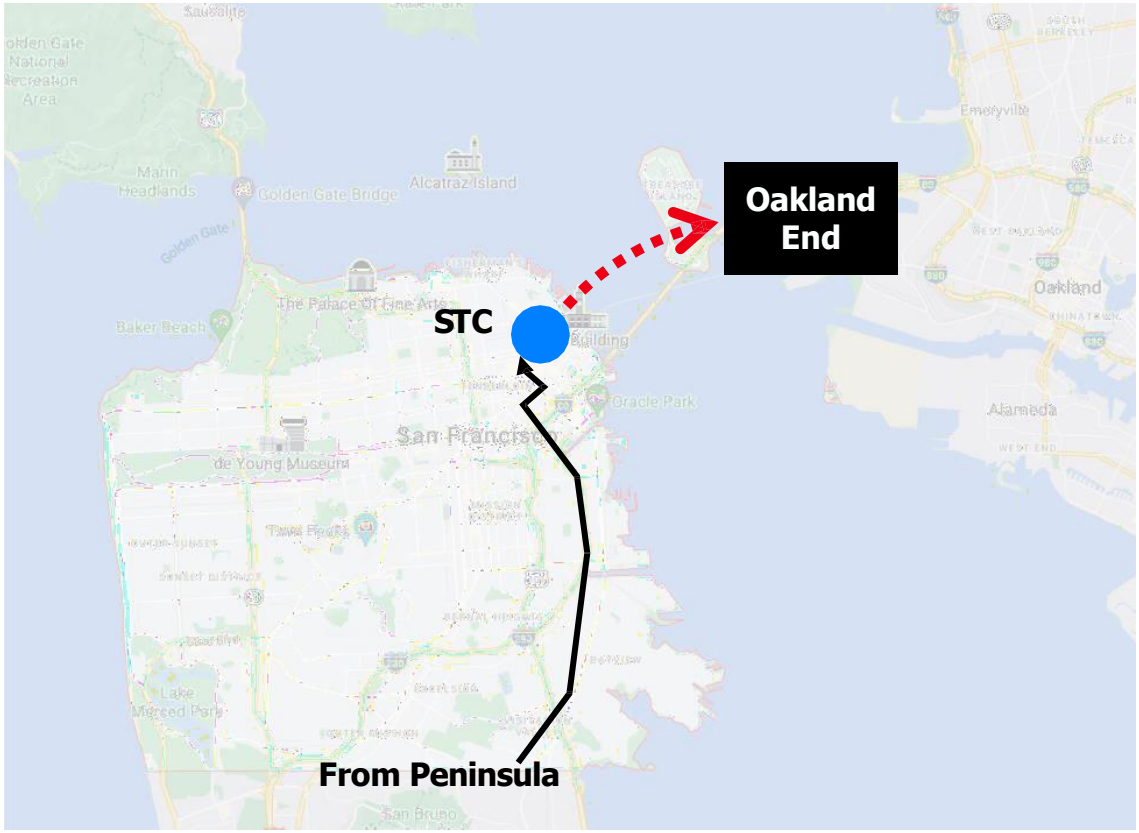
Context

The DTX-STC Run-Through Analysis is indicative and theoretical. It aims to provide an understanding of the hypothetical maximum capacity for trains operating through the Salesforce Transit Center (STC) via the proposed DTX infrastructure with different numbers of trains from the Peninsula terminating and reversing at STC.

The analysis used standardized and theoretical slots which are limited only to this analysis and are not related to the specific service plans in Caltrain's or California High Speed Rail's (HSR) business plan. This analysis assessed generic slots operating through the territory, specific slots were not allocated or defined for any operators.

The result of this analysis should not be used for decision making on the transbay tunnel due to unknown engineering conditions and service requirements on both ends of the tunnel. However, this analysis can provide inputs for future design of the transbay tunnel.

The Run-Through Analysis assessed the maximum **hypothetical** through-running capacity between CP Common and the Oakland end of the transbay section.



The task: Assess the maximum theoretical capacity for through-running trains between CP Common and Oakland end of the transbay section

The challenge: Identify through-running capacity on a complex alignment with vent zones, curves to STC, and interlocking layout in a confined urban area.

The approach: Use a standardized approach to assess the impact on the maximum through-running capacity with different number of trains per hour coming from the Peninsula terminating and reversing at STC.

The result: With standardized theoretical slots, STC can process up to 20 through trains per hour with no terminating trains. It can turn up to 12 terminating trains from the Peninsula with residual capacity to allow 4 trains to run through the station[1].

Conclusion: The through capacity is affected by number of turning trains and STC track usage.

(1) The slots for turning 12 trains are hypothetical and do not refer to the vision plan with 8 Caltrain and 4 California High-Speed Rail service per hour
Image Source: Google Maps

Planning parameters were defined and approved by Caltrain and HSR to facilitate the run-through analysis.

Planning Parameters

Defined by the railroads to represent minimum needs to operate a reliable service, or developed based on a simulation of train movements through specific areas of the system

STC Turn Time	20 Minutes
Dwell time (all stations)	1 minute
Minimum Tunnel Headway[1]	3 minutes
STC Platform Reoccupation for turning trains	Tracks 1 – 4: 4.5 Minutes Tracks 5 – 6: 2.7 Minutes
4&T Platform Reoccupation	2 minutes
Schedule Margin	10 Percent
Equipment	Generic electric multiple unit

Assumptions

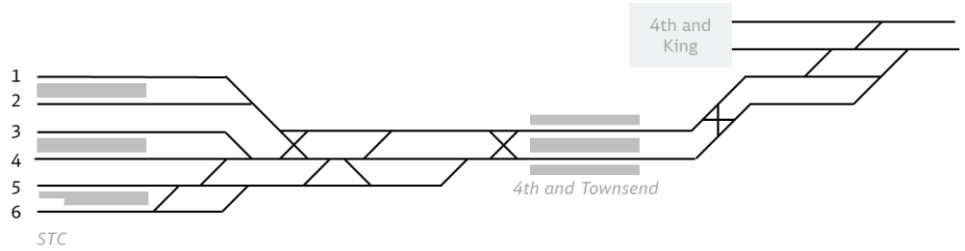
Defined by the railroads in the absence of engineering design to facilitate this theoretical analysis

- Concept C in the Operations Analysis was used for run-through analysis
- One train per track per vent zone
- All STC platform tracks to allow through-running into transbay tunnel
- Maximum 20 mph for through platform tracks and special trackwork
- Maximum 60 mph for new transbay crossing section
- Level gradient through transbay tunnel
- 5.5 miles between the special trackwork at both transbay section ends
- Sufficient infrastructure available at both transbay section ends
- All through-running trains to stop at both 4&T and at STC
- No stations between STC and the end of the transbay crossing section
- Reliability of slots not assessed for the theoretical capacity study

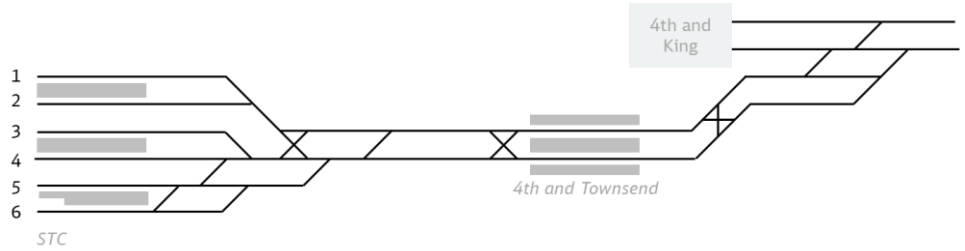
(1) Defined by vent zones

The task: Assess the maximum theoretical capacity for through-running trains between CP Common and Oakland end of the transbay section

Concept C



Concept C with a reduction of third track



Key Questions Addressed by the Analysis

- What is the available capacity with different number of trains terminating at STC?
- Will Concept C with a reduction of third track between 4th & Townsend and STC impact the maximum-through running capacity[1]?

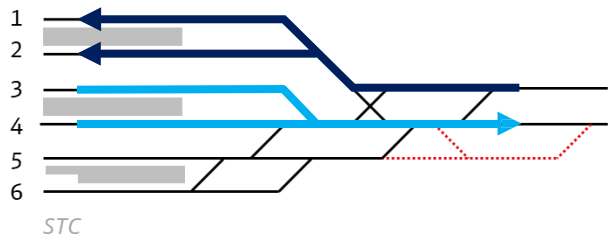
(1) This analysis examines if there will be an impact on the capacity with a reduction of the third track, assuming all turning trains come from the Peninsula. However, this analysis does not analyze if the full Concept C will provide additional benefits for trains coming from Oakland and turning at STC.

The challenge: Identify through-running capacity on a complex alignment with vent zones, curves to STC, and interlocking layout in a confined urban area

1 STC Interlocking

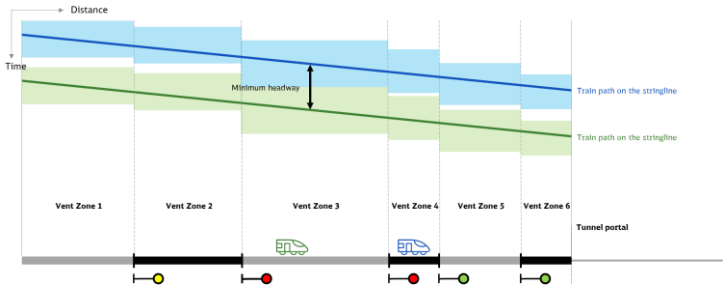
The configuration of the interlocking on approach to STC is fixed and provide only limited parallel movement between the platforms and the tunnel, increasing minimum separation times and limiting the overall capacity of the terminal.

This analysis began with the full Concept C infrastructure and assessed if the entire infrastructure will be necessary to support the maximum capacity.



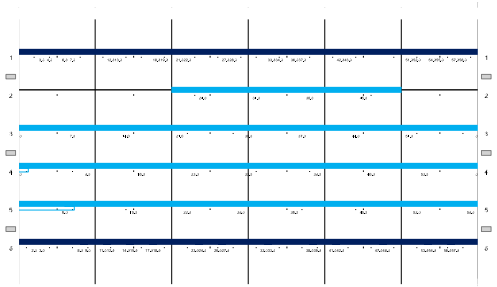
2 Vent Zone

One train per track per vent zone is allowed in the tunnel. There are six total vent zones that range from 800 feet to 2,300 feet. Transit time through each vent zone dictates how close following trains can be and limits the total throughput of the tunnel.



3 STC Platforms

Six tracks and three island platforms at STC were taken as a hard constraint (i.e., no other configurations were explored). This analysis assumed all platform tracks have access to the transbay tunnel. The capacity was analyzed by identifying which tracks are better for turning trains at STC that have less impact on the through-running trains, i.e., fewer conflicting movements.



The approach: Use a standardized approach to assess the impact on the maximum through capacity with trains from the Peninsula turning at STC

1

Define planning parameters & assumptions

- Infrastructure assumptions between CP Common and the Oakland end
- Minimum headway
- Operations requirements (e.g., turn time at STC, dwell time for through trains, etc.)

2

Assess capacity with trains from the Peninsula terminating at STC

- Identify the maximum through-running capacity with different number of trains at STC until no capacity exists to accommodate any more turning or through-running trains

3

Assess the impact on capacity with a reduction of the third track[1]

- Repeat the analysis from Step 2 to assess if a reduction of the third track between 4&T and STC impacts the maximum through-running capacity.

(1) This analysis examines if there will be an impact on the capacity with a reduction of the third track, assuming all turning trains come from the Peninsula. However, this analysis does not analyze if the full Concept C will provide additional benefits for trains coming from Oakland and turning at STC.

The result: With standardized theoretical slots, STC can process up to 20 thru trains per hour with no terminating trains. It can turn up to 12[1] terminating trains from the Peninsula with residual capacity to allow 4 trains to run thru the station.

- Theoretical maximum through-running capacity is 20 TPHPD based on the 3-minute headway defined in the parameters
- The through capacity decreases non-linearly as the number of trains from the Peninsula turning at STC increases (Figure 2)

  1) Turning 1 to 6[2] trains per hour has no conflicts (Figure 1A), so that each turning train will consume one through slot. For each train turned after six, two through slots will be consumed as a result of crossing conflicts between turning trains and through trains. (Figure 1B)

  2) Turning 9 to 12 trains per hour requires sharing tracks for turning and through trains that through slots are placed between turning trains. Thus, maximizing the capacity requires a selection of slots for turning and through trains and careful track assignment that minimizes crossing conflicts.

Figure 1A

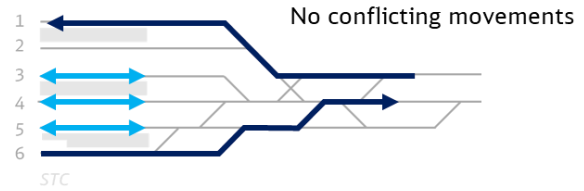


Figure 1B

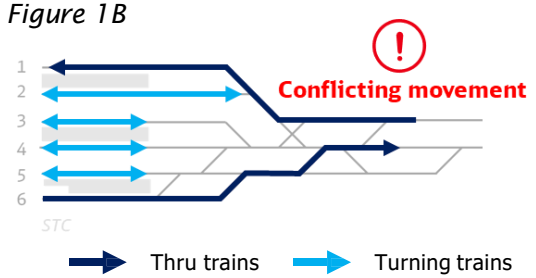
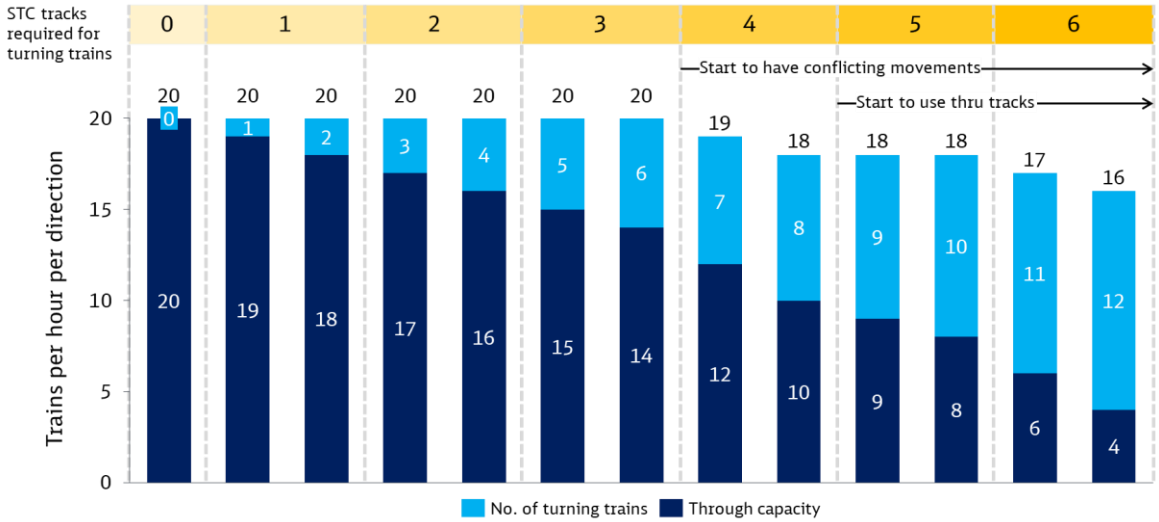


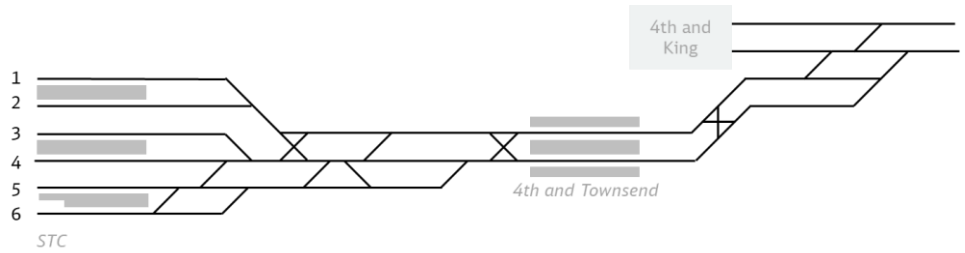
Figure 2: Maximum through-running capacity vs. Number of turning trains at STC



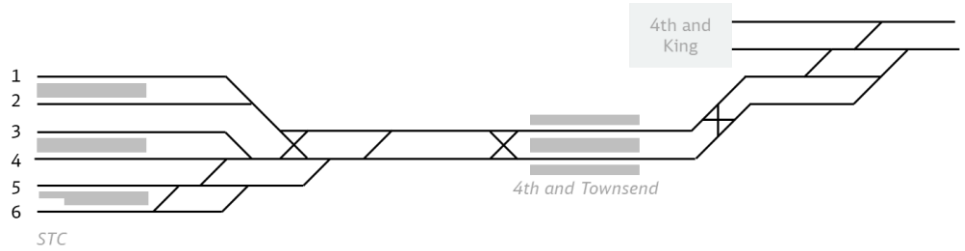
(1) The slots for turning 12 trains are hypothetical and do not refer to the vision plan with 8 Caltrain and 4 California High-Speed Rail service per hour
(2) Each track at STC can turn up to two trains per hour. Using Track 3, 4, and 5 (Figure 1A) can turn up to 6 trains without conflicts.

The conclusion: The through capacity is affected by number of turning trains and STC track usage.

Concept C



Concept C with a reduction of third track



Key Conclusions from the Analysis

- With no trains turning at STC, several combinations of tracks can support the theoretical maximum through capacity (20 trains per hour per direction) as long as they provide parallel movements between trains in the opposite directions.
- With mixed through and terminating trains from the Peninsula, the capacity at STC is maximized when through trains are on Tracks 1/2, and 6[1].
- A reduction of the third track in Concept C has no impact on the maximum capacity of the system when STC operates as a pure through station or if a subset of trains from the Peninsula terminate at the station.

(1) When turning more than 9 to 12 trains, mixed platform track usage for both through and turning trains is required. Optimal platform assignment is subject to slot allocations. In that case, Track 5/6 allows to place more through trains between the two turning trains due to shorter platform reoccupation time required.