The Mumbai Coastal Road Project:

Examining Induced Demand of Traffic

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Introduction

The 22.5 million people of Mumbai have places to be, work to do (World Population Review, 2026). Mumbai boasts a robust public transit system, consisting of many metro lines, several suburban rail lines, and hundreds of bus routes, all conveniently accessible to about 55% of the population (Asian Transport Observatory, 2024). On the flip side, Mumbai is significantly reliant on private transport, which contributes to the city being the 6th most congested in the world.

A common, brute force solution to the problem of traffic and congestion is simply to build more roads. Longer roads, wider roads, roads with more lanes, flyovers, highways, expressways. A new addition to the city's congestion-decreasing attempts is the Mumbai Coastal Road Project (hereafter MCRP). MCRP is planned to be a 30km, 8-lane freeway connecting Kandivali in North Bombay to Marine Lines in South Bombay (Egis, 2026). As of March 2026, the project is operational but all phases are not yet complete.

Due to the number of major corporate headquarters based in South Bombay, a huge chunk of Mumbai traffic moves North-South and back every single day, through the congested centre of the city — MCRP is the solution to that traffic, claiming it will decrease congestion, cut travel times, reduce air/noise pollution, add a Bus Rapid Transit (BRT) lane, increase property value, etc. etc. The bane of road traffic solutions is the phenomena of induced demand of traffic. This paper aims to numerically estimate the effects of induced demand on the MCRP.

Induced Demand

Induced demand refers to when "increasing the supply of a good or service leads to a rise in its consumption" (Environmental Registry of Ontario, 2024). This translates easily into transportation. As per Speck (2018):

> Traffic engineering theory is straightforward: a street is congested because the number of drivers exceeds its capacity. If you enlarge the street, you will eliminate congestion. Unfortunately, seventy-five years of evidence tells us that this almost never happens. Instead, what happens is that the number of drivers quickly increases to match the increased capacity, and congestion returns in full force. It's called induced demand. These new drivers are the people who were taking transit,

carpooling, commuting off-peak, or simply not driving because they didn't want to be stuck in traffic. When the traffic went away, they changed their habits. Maybe they even moved farther away from work, as the time-cost of their commute went down.

Induced demand may take a few years to show itself, but the result remains constant: sooner or later, MCRP should also be congested. Upon completion, end-to-end journeys (Kandivali to Marine Lines) will have significant time savings, travel times decreasing from 120 to 40 minutes (Godrej Properties Limited, 2025). MCRP has a design capacity of 1,30,000 vehicles per day (EPC World, 2022).

Process

This paper considers only induced demand caused by construction of the MCRP, and does not take into account additional factors influencing travel such as fuel prices, vehicle prices, driving incentives/disincentives, increase in public transport use, etc. Finer details of how congestion returns (switching mode of transport, buying a vehicle, etc.) are also out of the scope of this paper.

A common method to model induced demand is by using the following economic price elasticity equation. This equation essentially answers the question: with X change in price of a product, what is the Y change in demand. In transportation, the corresponding variables are time and vehicle-kilometres travelled (vehicle-km) respectively.

$$\boxed{\frac{\Delta VKT}{VKT_0} = \varepsilon \cdot \frac{\Delta T}{T_0}}$$

Here, ε serves as elasticity. Simply put, for every 1% decrease in travel time, vehicle-km increases by ε%. For urban trips, this technical paper will consider ε values 0.25 and 0.5 primarily (Thomas & Serrenho, 2026; Litman, 2010). This paper will also consider $\varepsilon\ \bar{0}.75$ and time savings deviations for sensitivity analysis. This equation provides us with the quantity of induced traffic.

As induced demand increases congestion, travel time increases once more. This is modelled with the volume-delay relationship described below (Gore et al., 2023). Known as the Bureau of Public Roads Link Function, it is a standard formula used in transport planning. The formula simply measures how travel speed decreases as congestion increases. Hence, our process is two-step: with a 67% reduction in travel time, by how much does congestion change, and then as congestion increases, how much does travel time increase. The model runs this as a feedback loop: the elasticity equation yields additional vehicles, which are added to the opening-day volume, and the BPR function then returns the new equilibrium travel time. See Appendix A for further information on the formulae and variable values.

$$\boxed{T = T_0 \left(1 + \alpha \left(\frac{V}{C}\right)^{\beta}\right)}$$

Results

Within the above constraints, a model was written in Python (refer Appendix B).

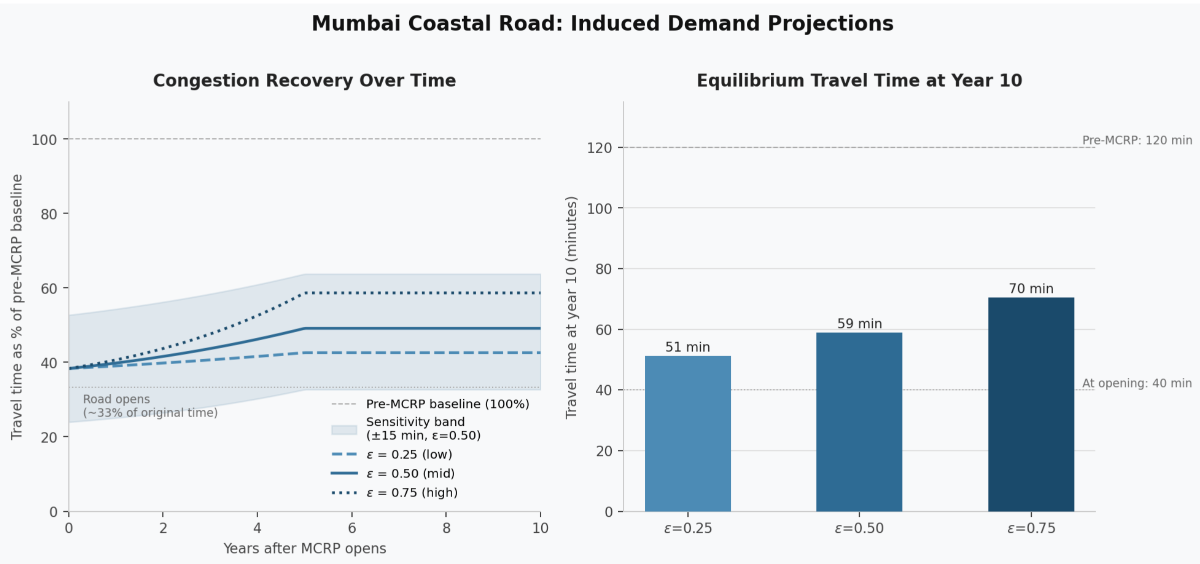

Figure 1: Induced Demand Projections for the Mumbai Coastal Road

Insights

The model results suggest in a decade, induced demand reduces the time saving benefits significantly. The time savings, originally decreasing travel time by 67% of pre-MCRP, erode to 57% minimum or 42% maximum. These numbers are dependent on elasticity and time horizon considered, and display large deviations from the promised 67%. A key insight here is that the MCRP does not become redundant, but its benefits certainly will reduce by a serious margin.

Considering the median case of 0.5 elasticity, which is probable due to Mumbai's high demand growth rate (Shaban & Sattar, 2023), MCRP's benefits decline by half. While the benefits do not disappear, such discounts in benefits can easily be a case against the project.

This paper simplifies certain parameters: assuming linear buildup of elasticity and the project opening at design capacity. Elasticity numbers are drawn from various sources, local Mumbai numbers may vary. The core finding of the paper however is robust across multiple parameter ranges, as demonstrated by the sensitivity analysis.

Conclusion

The model reaffirms the induced demand of traffic as put forward by Speck (2018) earlier. In case of the MCRP, the project does not cease to be of use — but the major dent in benefits due to induced demand can make the project arguable. A case can be made for investing the MCRP's Rs. 15,000 Cr. (approximately) budget into public transport, which has shown to do much more to reduce a city's congestion; public transit moves a major chunk of Mumbai's population currently, even while overburdened. The model for induced demand showcases that new highways such as the MCRP do reduce travel time, but not permanently, and not always by the promised quantity. Highways have their position in the transportation industry, but their utilization as an easy 'solution' to congestion excludes multiple, more efficient solutions from entering the urban environment.

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Appendix A: Model

Disclaimer: AI tools were used to assist in formulating the mathematical structure of the induced demand model and generating the initial Python code for calculations. All assumptions, parameter choices, interpretation of results, and written analysis are of the author's. AI was used as a computational aid, not for generating any essay content.

The elasticity equation for induced demand:

$$\frac{\Delta VKT}{VKT_0} = \varepsilon \cdot \frac{\Delta T}{T_0}$$

Let:

- ΔVKT = change in vehicle-kilometres travelled due to induced demand
- VKT_0 = baseline vehicle-kilometres travelled before MCRP
- ε = elasticity of vehicle-km with respect to travel time
- ΔT = change in travel time (reduction at road opening)
- T_0 = baseline travel time before MCRP

The Bureau of Public Roads (BPR) volume-delay function:

$$T = T_f \left(1 + \alpha \left(\frac{V}{C}\right)^{\beta}\right)$$

Let:

- T = travel time at volume V
- T_f = free-flow travel time (travel time immediately after road opens)
- V = traffic volume (vehicles/day)
- C = road capacity (vehicles/day)

- α, β = standard BPR calibration parameters

Parameter values used:

Parameter	Value	Source
T_0 (baseline travel time)	120 minutes	Godrej Properties Limited (2025)
T_f (free-flow travel time)	40 minutes	Godrej Properties Limited (2025)
C (road capacity)	1,30,000 vehicles/day	EPC World (2022)
V_0 (opening volume)	1,30,000 vehicles/day	Conservative assumption
ε (elasticity)	0.25, 0.50, 0.75	Thomas & Serrenho (2026); Litman (2010)
α	0.15	Standard BPR value
β	4	Standard BPR value

Results: Year-10 Equilibrium Travel Times

- Linear buildup to full elasticity effect over 5 years, stable thereafter
- Sensitivity band: ± 15 minutes on free-flow travel time (T_f), at $\varepsilon = 0.50$

Elasticity (ε)	Travel Time (min)	% of Pre-MCRP Baseline
0.25	51.1	42.6%
0.50	59.0	49.1%
0.75	70.4	58.6%

- Travel time at opening: 40 minutes (33% of pre-MCRP baseline)
- Pre-MCRP baseline: 120 minutes (100%)

Appendix B: Code

```
import numpy as np
import matplotlib.pyplot as plt

T0 = 120          # baseline travel time (minutes), pre-MCRP
T_central = 40    # post-opening travel time, central case (minutes)
T_opt = 25        # optimistic bound (±15 min)
T_cons = 55       # conservative bound (±15 min)
C = 130000        # design capacity (vehicles/day)
V0 = 130000       # opening volume (assumes road opens at capacity)
alpha = 0.15      # BPR parameter
beta = 4          # BPR parameter
epsilons = [0.25, 0.50, 0.75]
years = np.linspace(0, 10, 200)

def bpr_time(V, T_freeflow, C):
    return T_freeflow * (1 + alpha * (V / C) ** beta)

def simulate(T_after, epsilon, years):
    frac_saved = (T0 - T_after) / T0
    full_delta_V = V0 * epsilon * frac_saved
    travel_times = []
    for yr in years:
        ramp = min(yr / 5.0, 1.0)
        V_new = V0 + full_delta_V * ramp
        travel_times.append(bpr_time(V_new, T_after, C))
    return np.array(travel_times)

results = {eps: simulate(T_central, eps, years) for eps in epsilons}
band_opt = simulate(T_opt, 0.50, years)
band_cons = simulate(T_cons, 0.50, years)
```