耐震設計
Seismic Design

目標とする耐震性能 Target Seismic Performance

トンネル構造 Tunnel structures

地震動レベル Earthquake Motion Level	対象地震動 Description of Earthquake Motion	目標とする耐震性能 Target Seismic Performance		
		安全性 Safety	機能性 Functionality	復旧性 Recoverability
レベル1地震動 Level 1	比較的生じる可能性の高い中規模程度の地震による地震動 Level 1 is the motion of a medium-class earthquake. Such earthquakes are fairly common.	地震時の利用者に対する安全性を確保 The safety of all motorists should be assured when this level of earthquake occurs.	地震直後にも一般車両の通行が可能 Most vehicles can continue to travel on the highway immediately following such an earthquake.	通行止めを伴う補修・補強不要 Closing the highway for repair or reinforcement is not necessary when this level of earthquake occurs.
レベル2地震動 Level 2	道路橋示方書で定めるタイプⅠの地震動（プレート境界型の大規模な地震） According to the Japanese Code for Highway Bridges, Level 2 motion is typical of a Type I earthquake (an undersea quake occurring at the boundary of tectonic plates).	地震時の利用者に対する安全性を確保 The safety of all motorists should be assured when this level of earthquake occurs.	地震直後にも緊急車両の通行が可能 Emergency vehicles can continue to travel on the highway immediately following such an earthquake.	補修・補強により当初の機能回復が可能 Repair or reinforcement recovers the original functions of the highway.
	道路橋示方書で定めるタイプⅡの地震動（兵庫県南部地震のような内陸直下型地震） According to the Japanese Code for Highway Bridges, Level 2 motion is typical of a Type II earthquake (directly above the epicenter of an inland earthquake, such as the Great Hanshin Earthquake).			
最大級シナリオ地震動 Maximum earthquake scenario	上町断層系を震源とするシナリオ地震動 The maximum level is the motion resulting from an earthquake assumed to have its epicenter over the Uemachi Fault.	構造物全体系が崩壊せず、地震時の利用者に対する安全性を確保 Destruction of the entire structure should be prevented and the safety of all motorists should be assured in the event of such an earthquake.	―	―

橋梁構造 Bridge structures

地震動レベル Earthquake Motion Level	対象地震動 Description of Earthquake Motion	目標とする耐震性能 Target Seismic Performance		
		安全性 Safety	機能性 Functionality	復旧性 Recoverability
レベル1地震動 Level 1	比較的生じる可能性の高い中規模程度の地震による地震動 Level 1 is the motion of a medium-class earthquake. Such earthquakes are fairly common.	落橋に対する安全性を確保 To ensure of safety against girder unseating.	地震直後にも一般車両の通行が可能 Most vehicles can continue to travel on the highway immediately following such an earthquake.	通行止めを伴う補修・補強不要 Closing the highway for repair or reinforcement is not necessary when this level of earthquake occurs.
レベル2地震動 Level 2	道路橋示方書で定めるタイプⅠの地震動（プレート境界型の大規模な地震） According to the Japanese Code for Highway Bridges, Level 2 motion is typical of a Type I earthquake (an undersea quake occurring at the boundary of tectonic plates).	落橋に対する安全性を確保 To ensure of safety against girder unseating.	地震直後にも緊急車両の通行が可能 Emergency vehicles can continue to travel on the highway immediately following such an earthquake.	補修・補強により当初の機能回復が可能 Repair or reinforcement recovers the original functions of the highway.
	道路橋示方書で定めるタイプⅡの地震動（兵庫県南部地震のような内陸直下型地震） According to the Japanese Code for Highway Bridges, Level 2 motion is typical of a Type II earthquake (directly above the epicenter of an inland earthquake, such as the Great Hanshin Earthquake).			
	地域特性を考慮したシナリオ地震動 Level 2 is the motion resulting from an earthquake that could occur in a specific region.			

地震動レベルは従来のレベル１地震動およびレベル２地震動に加えて、上町断層系を震源とするシナリオ地震動等の地域特性を考慮したものを設定しています。また、目標とする耐震性能はこれらの地震動に対応して、安全性・機能性・復旧性の観点からそれぞれ設定しています。

なお、トンネル構造で考慮する「最大級シナリオ地震動」は、レベル２地震動を超える非常に大きな地震動であることから、目標とする耐震性能は安全性のみ確保することとしています。

Conventionally, two earthquake motion levels have been used; Level I and Level II. We have added a third level, which we call the Maximum Level, as we must consider the motion of an earthquake that could occur in a certain region; an earthquake with its epicenter on the Uemachi Fault. We have established a target seismic performance for each type of earthquake motion from the viewpoints of safety, functionality, and recoverability.

For tunnel structures, the maximum level (earthquake scenario) is an extremely large earthquake motion, exceeding that of Level 2. For this reason, the target seismic performance has been adopted for safety purposes only.

大和川線（トンネル構造）における最大級シナリオ地震動の設定
Adopting the Highest Possible Earthquake Motion Scenario for Construction of the Tunnel Structures of the Yamatogawa Route

大和川線は、南部上町断層を横断する形で路線が計画されているため、トンネル構造物の耐震設計にあたっては、上町断層系の破壊により生じる地震動を考慮しています。

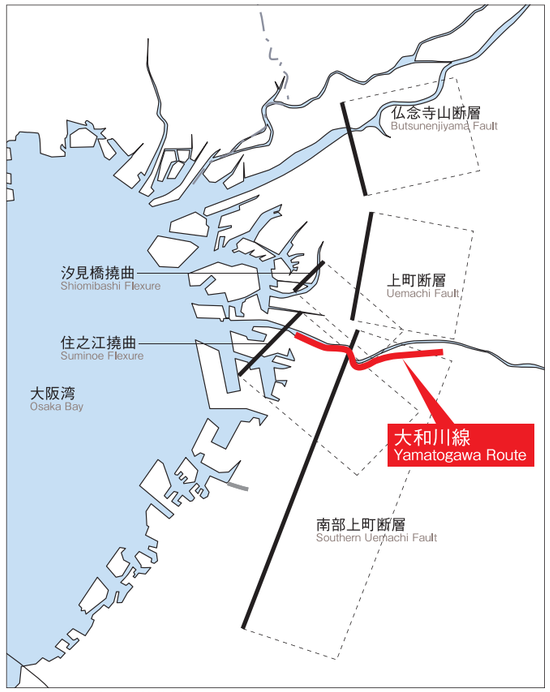
最大級地震動の設定における断層破壊のシナリオは、上町断層系を仏念寺山・上町・南部上町断層、汐見橋・住之江撓曲からなる断層モデルとして作成し、断層モデルの破壊に応じた断層破壊モデルを設定しています。

設計地震動は、こうした上町断層系の想定断層破壊シナリオを反映した地震動予測手法により、耐震設計に用いるための地震動評価を実施し、アスペリティ*と破壊開始点を変えた複数の断層破壊シナリオの中でも大和川線に最も大きな影響を及ぼす地震動を「最大級シナリオ地震動」として設定しています。

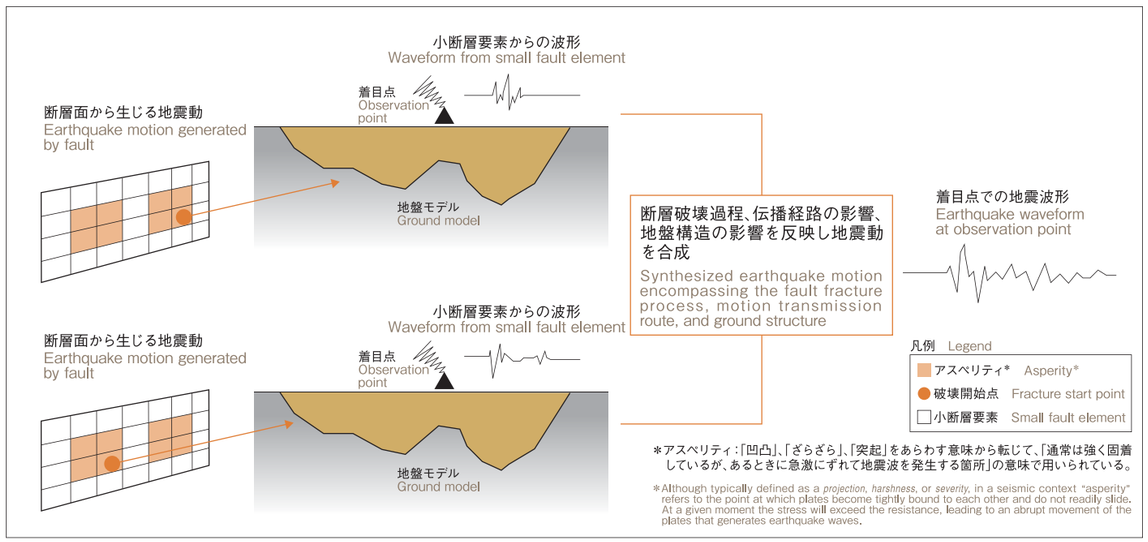
The Yamatogawa Route is planned to cross the Southern Uemachi Fault. We have therefore decided that destructive earthquake motion directly above the Uemachi Fault should be considered in the design of the tunnel structures.

We have prepared scenarios for an earthquake triggered by fracture of one of the existing faults (Butsunenjiyama Fault, Uemachi Fault, Southern Uemachi Fault, Shiomibashi Flexure, or Suminoe Flexure) and have developed a fault fracture model for each fault.

In considering these fault fracture scenarios, we have evaluated possible earthquake motions to determine the design earthquake motion. We have prepared several scenarios while changing the asperity* and the fracture start point and have selected one scenario that could greatly affect the Yamatogawa Route. We have assigned the “maximum level” of earthquake motion to this earthquake scenario.



上町断層系と大和川線位置図
Uemachi Fault and other faults applicable to the Yamatogawa Route



＊アスペリティ：「凹凸」、「ざらざら」、「突起」をあらわす意味から転じて、「通常は強く固着しているが、あるときに急激にずれて地震波を発生する箇所」の意味で用いられている。

＊Although typically defined as a *projection*, *harshness*, or *severity*, in a seismic context “asperity” refers to the point at which plates become tightly bound to each other and do not readily slide. At a given moment the stress will exceed the resistance, leading to an abrupt movement of the plates that generates earthquake waves.

最大級シナリオ地震動設定の考え方　How to set the maximum earthquake motion for an earthquake scenario