

2.3 Seismic Conditions

Earthquake intensity is an important factor to consider in designing transport infrastructure. For transport engineering purposes, seismic force is estimated based on seismic acceleration on the ground surface when an earthquake attacks and on seismic coefficient method used universally. In Japan, the acceleration on the ground surface in case of a strong earthquake can be estimated by a measuring instrument installed at a fixed point (meteorological observation stations, earthquake observation stations, etc.). Analyzing the data obtained from observation points and structural damage, the relation between seismic coefficient and seismic acceleration on the ground surface gradually becomes clear.

Table 2.3.1 lists the earthquake epicenters and their seismic grades, while Figure 2.3.1 shows a zone map of seismic levels in the country. In Vietnam, more earthquakes occur in the north than in the south. Figure 2.3.2 shows the locations of earthquake epicenters. Here, large fault lines lie along the Red River, Chay River, Da River, Ma River, Con River, Ca River, Bac Son mountain range and the mountains in western Lai Chau Province. Earthquakes with a magnitude of 4.6-7.0 are frequently recorded in these areas.

Railway sections from Hanoi to Lao Cai and Dong Dang and national roads such as Route 1A, 1B, 2, 4D, 6, 7, 8, 12, 15, 32, 70, and 279 are built on or slightly away from these high seismic intensity zones. On account of these large fault lines and earthquakes, the ground in these areas weakens and once heavy rain falls, landslides occur in almost all parts of these areas. Hence, countermeasures should be taken to protect transport infrastructures, such as roads, railways, ports, and airports, from damage and to rehabilitate them.

Table 2.3.1
 Locations of Earthquake Epicenters and their Seismic Grades

Province	City/town, Residential Area	Grade	Province	City/town, Residential Area	Grade	
Hanoi	Cac quan noi thanh	8	Ha Giang	Thi xa Ha Giang	6	
	Thi tran Gia Lam	8		Pho Bang	6	
	Thi tran Van Dien	8		Quang Ba	6	
	Huyen Tu Liem	8		Meo Vac	6	
	Huyen Soc Son	7		Bac Quang	6	
	Thi tran Yen Vien	7		Xin Man	6	
Haiphong	Khu vuc noi thanh	7	Tuyen Quang	Thi xa Tuyen Quang	7	
	Thi xa Kien An	7		Yen Son	7	
	Thi tran Do Son	7		Son Duong	7	
	Huen Tien Lang	7		Ham Yen	7	
	Huyen Thuy Nguyen	7		Na Hang	6	
	Huyen An Hai	7		Vinh Loc	6	
	Huyen An Thuy	7	Cao Bang	Thi xa Cao bang	7	
	Huyen Cat Hai	7		Ha Quang	7	
Ho Chi Minh	Cac quan noi thanh	7	Cao Bang	Dong khe	7	
	Thi tran Nha Be	7		Nuoc Hai	7	
	Huyen Thu Duc	6		Tra Linh	7	
	Quan Go Vap	6		Bac Loc	6	
Lan Son	Thi Xa Lan Son	7		Ngan Son	6	
	That Khe	7		Quang Hoa	6	
	Na Sam	7		Trung kanh	6	
	Dong Dang	7		Ba Be	6	
	Cao Loc	7		Phuc Hoa	6	
	Loc Binh	7		Nguyen Binh	6	
	Dong Mo	6		Tinh Tuc	6	
	Huu Lung	6		Lai Chau	Thi xa Lai Chau	8÷9
	Bac Son	6			Dien Bien	8÷9
	Van Quan	6			Tuan Giao	8÷9
	Binh Gia	6	Tua Chua		8÷9	
			Sin Ho		8÷9	
		Muong lay	8			
		Phong Tho	8			
		Muong Te	7			
Yen Bai	Thi xa Yen Bai	8	Lao Cai	Thi xa Lao Cai	8	
	Tran Yen	8		Bat Xat	8	
	Yen Binh	8		Cam Duong	8	
	Luc Yen Tram Tau	8		Pho lu	8	
	Nghia Lo	7		Bac Ha	7	
	6	Than Uyen		7		
		Van Ban		7		
		Sa Pa		6		
		Mu Cang Chai		6		
		Si-ma-cai		6		

Table 2.3.1 cont'd

Province	City/town, Residential Area	Grade	Province	City/town, Residential Area	Grade
Bac Thai	Thanh pho Thai Nguyen	7	Son La	Thi xa Son La	8÷9
	Mo che	7		Moc Chau	8÷9
	Pho Yen	7		Thuan Chau	8÷9
	Phu Binh	7		Yen Chau	8÷9
	Dai Tu	7		Mai Son	8÷9
	Dong Hy	7		Muong la	8÷9
	Bac Can	6		Pha Din	8÷9
	Cho Don	6		Song Ma	8÷9
	Cho Chu	6		Quynh Nhai	8÷9
	Trai Cau	6		Phu Yen	7
	Cho Moi	6		Van Yen	7
	Vo Nhai	6		Bac Yen	7
Vinh Phu	Thanh Pho Viet Tri	8	Quang Ninh	Thi xa Hon Gai	7
	Phu Tho	8		Cam pha	7
	Vinh Yen	8		Hoanh Bo	7
	Lam Thao	8		Bai Chay	7
	Ha Hoa	8		Uong Bi	7
	Thanh Ba	8		Dong Trieu	7
	Cam Khe	8		Mao Khe	7
	Phu Ninh	8		Vang Danh	7
	Tam Dac	7		Mong Duong	7
	Lap Thach	7		Binh Lieu	6
	Phuc Yen	7		Mong Cai	6
	Yen Lap	7			
Thanh Son	7				
Ha Bac	Gia Luong	8	Hoa Binh	Mai Chau	8÷9
	Thuan Thanh	8		Xuan Mai	8
	Thi xa Bac Giang	7		Suoi Rut	8
	Bac Ninh	7		Da Bac	8
	Luc Ngan	7		Tan Lac	8
	Son Dong	7		Thi xa Hoa Binh	7
	Luc Nam	7		Yen Thuy	7
	Que Vo	7		Lac Thuy	7
	Tu son	7		Ky Son	7
	Tien Du	7		Kim Boi	7
	Yen Phong	7	Hai Hung	Hung Yen	8
	Yen Dung	7		Tien Lu	8
	Yen The	7		Kim Dong	8
	Nha Nam	7		Khoai Chau	8
	Duc Thang	7		Phu Cu	8
	Viet Yen	7		Van Giang	8
				Yen My	8
				Thi xa Hai Duong	7
				Ke Sat	7
				Gia Loc	7
		Tu Ky	7		
		Pha Lai	7		
		Thanh Ha	7		
		Kim Mon	7		

Table 2.3.1 cont'd

Province	City/town, Residential Area	Grade	Province	City/town, Residential Area	Grade
Ha Tay	Thi xa Ha Dong	8	Nam Ha	Thanh pho Nam Dinh	8
	Quoc Oai	8		Thi xa Phu Ly	8
	Van Dinh	8		Ly Nhan	8
	Thanh Oai	8		Nam Ninh	8
	Thuong Tin	8		Nghia Hung	8
	Phu Xuyen	8		Hai Hau	8
	Son Tay	8		Xuan Thuy	8
	Da Bac	8		Duy Tien	8
	Ky Son	8		Cho Con	8
	Kim Boi	8			
Tan Lac	8				
Thai Binh	Thi xa Thai Binh	8			
	Kien Xuong	8			
	Vu Thu	8			
	Hung Ha	8			
	Tien Hai	8			
	Dong Hung	8			
	Thai Thuy	7			
Quynh phu	7				
Ninh Binh	Thi xa Ninh Binh	7	Thanh Hoa	Thi xa Thanh Hoa	8÷9
	Tamp Diep	7		Nhu Xuan	8÷9
	Phat Diem	7		Lang Chanh	8÷9
	Nho Quam	7		Ba Thuoc	8÷9
	Gia Khanh	7		Cam Thuy	8÷9
	Yen Mo	7		Thach Thanh	8÷9
	Gia Vien	7		Vinh Loc	8÷9
Nghe An	Thanh pho Vinh	8	Ha Tinh	Yen Dinh	8÷9
	Nam Dan	8		Nogc Lac	8÷9
	Thanh Chuong	8		Tho Xuan	8÷9
	Ky son	8		Trieu Son	8÷9
	Tuong Duong	8		Dong Son	8÷9
	Con Cuong	8		Nong Cong	8÷9
	Anh Son	8		Tinh Gia	8
	Do Luong	8		Thuong Xuan	8
	Cau Giat	7		Quan Hoa	8
	Yen Thanh	7		Thi xa Ha Tinh	8
	Que Phong	7		Duc Tho	8
	Quy Chau	7		Huong Son	7
	Thai Ha	7		Ky Anh	7
	Quy Hop	6		Huong Khe	7
		Cam Xuyen	6		
		Thach Ha	6		
		Can Loc	6		
Quang Binh	Tuyen Hoa	7	Quang Tri	Thi xa Quang Tri	6
	Thi xa Dong Hoi	6		Thi xa Dong Ha	6
	Minh Hoa	6		Cam Lo	6
	Bo Trach	6		Hai Lang	6
	Le Thuy	6		Ho Xa	6
	Le Ninh	6			

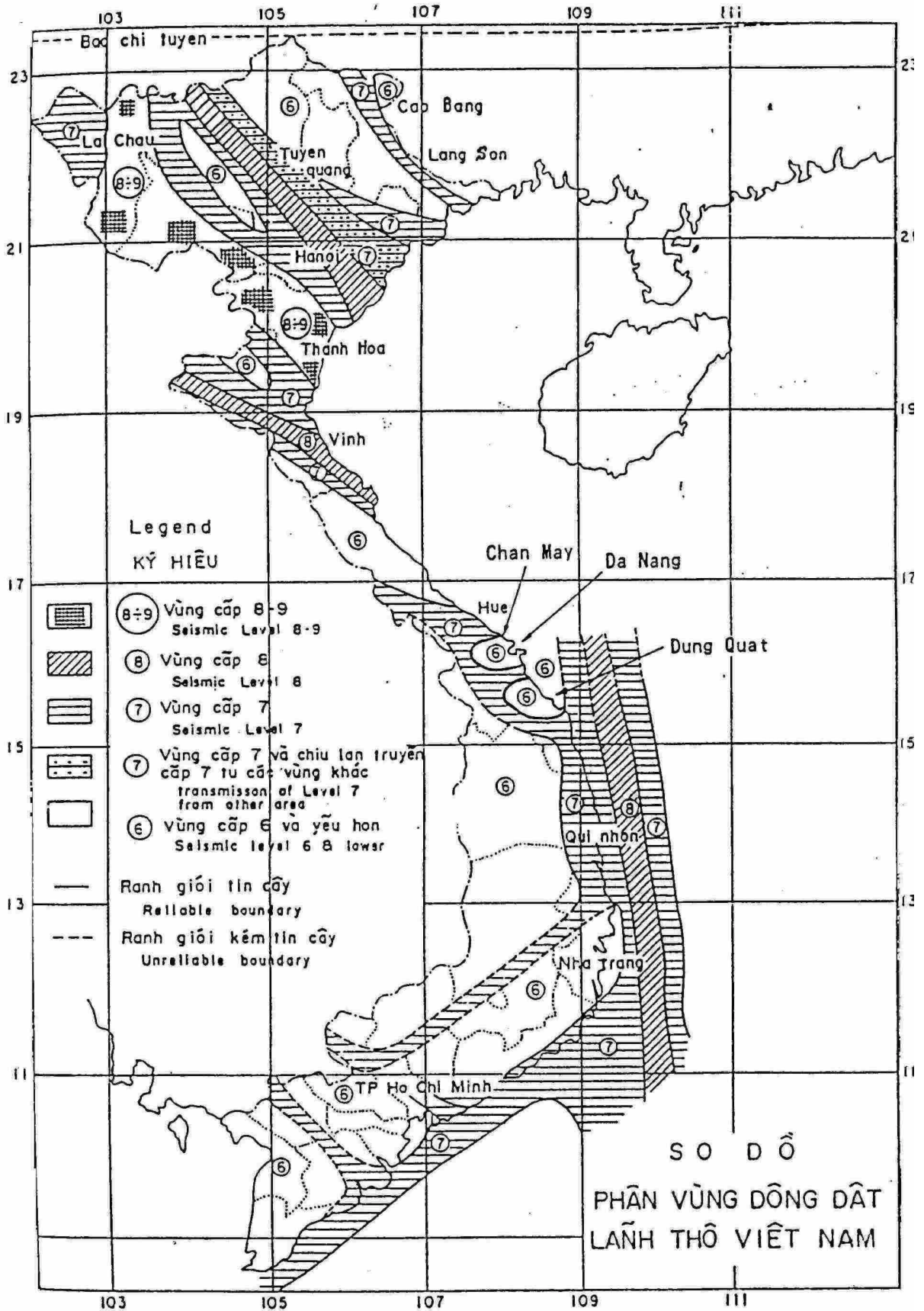
Table 2.3.1 cont'd

Province	City/town, Residential Area	Grade	Province	City/town, Residential Area	Grade	
Thua Thien Hue	Thanh pho Hue	7	Quang Nam - Da Nang	Thanh pho Da Nang	7	
	Huong Hoa	7		Hieu Duc	7	
	Huong Thuy	7		Hoa Vang	7	
	Quang Dien	7		Thuong Duc	7	
	Huong Tra	7		Thang Binh	7	
	Phong Dien	6		Ly Tin	7	
	Phu Loc	6		Tam Ky	7	
Phu Yen	Thi xa Tuy Hoa	7		Hiep Duc	7	
	Song Cau	7		Tra My	7	
	Tuy Hoa	7		Hoi An	6	
	Deo Ca	7		Dien Ban	6	
	Cung Son	6		Dai Loc	6	
Quang Ngai	Thi xa Quang Ngai	7		Tien Phuoc	6	
	Binh Son	7	Binh Dinh	Thi xa Quy Nhon	7	
	Tra Bong	7		Sa Huynh	7	
	Duc Pho	7		Tam Quan	7	
	Tu Nghia	7		Bong Son	7	
	Song Ve	7		Hoia An	7	
	Mo Duc	7		Phu My	7	
	Son Tra	6		Phu Cat	7	
	Minh Long	6		Van Canh	7	
Khanh Hoa	Thanh pho Nha Trang	6		Tuy Phuoc	7	
	Ninh Hoa	6	Binh Khe	7		
	Dien Khanh	6	Binh Thuan	Thi xa Phan Thiet	7	
	Cam Ranh	6		Phan Ri	7	
	Cam Lam	6		Ham Tan	7	
	Van Ninh	6		Tuy Phong	7	
Ninh Thuan	Ca Na	7		Phan Ly	7	
	Thi xa Phan Rang	6		Ham Thuan	7	
	Buu Son	6	Gia Lai	Thi xa Play Cu	6	
	Ninh Phuoc	6		An Khe	6	
	An Phuoc	6		Le Trung	6	
	Thien Giao	6		Le Thanh	6	
Kom Tum	Thi xa Kon Tum	6		Thuan Man	6	
	Kon Plong	6		Phu Nhon	6	
	Dac To	6	Mang Yang	6		
	Dac Sut	6	Krong pa	6		
	Dac Lac	Phu Khuong	7	Lam Dong	Thanh pho Da Lat	6
		Gia Nghia	7		Dran	6
		Thi xa Ban Me Thuot	6		Duc Trong	6
		Cheo Reo	6		Di Linh	6
M'drak		6	Bao Loc		6	
Ban Don		6	Gia Bac		6	
Duc Lap (Dkmill)		6				
Buon Ho	6					

Table 2.3.1 cont'd

Province	City/town, Residential Area	Grade	Province	City/town, Residential Area	Grade
Song Be	Thi xa Thu Dau mot	6	Tay Ninh	Go dau ha	7
	Kien Duc	6		Trang Bang	7
	Phuoc Hoa	6		Ben Cau	7
	Duc Phong	6		Cho Moi	7
	Ba Ra	6		Cai Tau	7
	Phu Rieng	6		Tan Chau	7
	Lai Thieu	6		Thi xa Tay Ninh	6
	Dong Xoai	6		Loc Ninh	6
	Dong Phu	6	Dong Nai	Quang Xuyen	7
	An Loc	6		Thanh pho Bien Hoa	6
	Binh Long	6		Long Thanh	6
	Dau Tieng	6		Dat Do	6
				Xuan Loc	6
			Ngoai Giao	6	
Tien Giang	Thanh pho My Tho	6	Dong Thap	Thi xa Sa Dec	6
	Cho Gao	6		Cao Lanh	6
	Cai Lay	6		Hong Ngu	6
	Go Cong	6		Tuyen Binh	6
	Cai Be	6			
	Chau Thanh	6			
Long An	Duc Hoa	7	Can Tho	Thot Not	7
	Thi xa Tan An	6		Thanh pho Can Tho	6
	Thu Thua	6		Omon	6
	Can Gioc	6		Vi Thanh	6
	Duc Hue	6	Soc Trang	Thi xa Soc Trang	6
	Moc Hoa	6		Ke sach	6
	Tuyen Nhon	6			
	Ben Luc	6			
An Giang	Thi xa Long Xuyen	7	Vinh Long	Thi xa Vinh Long	6
	Chau Doc	7		Vung Liem	6
	Cho Moi	7	Ben Tre	Thi xa Ben Tre	6
	Chau Phu	7		Mo Cay	6
Tra Vinh	Tieu Cau	7	Giong Trom	6	
	Tra Cu	7	Ba Tri	6	
	Thi xa Tra Vinh	6			
Kien Giang	Thi xa Rach Gia	6	Minh Hai	Thi xa Bac Lieu	6
	Ha Tien	6		Thi xa Ca Mau	6
	Hon Dat	6		Ngoc Hieu	6
	Go Quao	6		Gai Quao	6
	Giong Rieng	6		Giong Rieng	6
Ba Ria – Vung Tau	Thi xa Vung Tau	7			
	Chau Thanh	7			
	Xuyen Moc	7			
	Long Dat	7			

Figure 2.3.1 Zone Map of Seismic Levels



Source: TEDI

Figure 2.3.2 Locations of Earthquake Epicenters

