Ministry of Transport and Communication
The United Republic of Tajikistan

No.

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR
REHABILITATION OF KURGAN TYUBE-DUSTI ROAD
IN
THE REPUBLIC OF TAJIKISTAN

JANUARY 2008

JAPAN INTERNATIONAL COOPERATION AGENCY

CONSTRUCTION PROJECT CONSULTANTS, INC.

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PREFACE

In response to a request from the Government of the Republic of Tajikistan, the Government of Japan decided to conduct a basic design study on the Project for Rehabilitation of Kurgan Tyube-Dusti Road and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Tajikistan a study team from June 12 to July 21, 2007.

The team held discussions with the officials concerned of the Government of Tajikistan, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Tajikistan in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Tajikistan for their close cooperation extended to the teams.

January 2008

Masafumi Kuroki
Vice-President
Japan International Cooperation Agency

January 2008

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Rehabilitation of Kurgan Tyube-Dusti Road in the Republic of Tajikistan.

This study was conducted by Construction Project Consultants, Inc., under a contract to JICA, during the period from June, 2007 to February, 2008. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Tajikistan and formulated the most appropriate basic design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Hideaki Morita
Project manager,
Basic design study team on
the Project for Rehabilitation of Kurgan
Tyube-Dusti Road
Construction Project Consultants, Inc.

SUMMARY

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(1) Overview of Tajikistan

The Republic of Tajikistan (hereinafter referred to as "Tajikistan") became independent from the Soviet Union in 1991 but suffered a civil war which started in 1992 and lasted for five years and subsequent economic stagnation. In 2000, a parliamentary election was held to complete the peace process but the government today still faces such problems as a chronic budgetary shortfall and an increase of the unemployment rate.

93% of Tajikistan's national land is mountainous and road transportation is the principal means of physical distribution and trade with neighbouring countries. Therefore, the trunk roads stretching from Dushanbe, the capital, and other major cities to neighbouring countries constitute important economic infrastructure for the country. Most of these trunk roads, however, were originally constructed during the former Soviet period and their deterioration and damage due to the civil war and natural aging are major impediment factors for the economic vitalisation of Tajikistan. Under these circumstances, the Government of Tajikistan has formulated a "long-term transport development plan" every five years to improve the trunk road network in order to systematically develop the transport infrastructure although the funding for such development has been almost exclusively dependent on foreign aid due to the chronic budgetary shortfall.

(2) Background, History and Outline of the Project

The major trunk road (International Trunk Road No. 11 which is former National Road No. 384) linking the capitals of Tajikistan and neighbouring Afghanistan is given priority status for improvement in Tajikistan's Long-Term Transport Development Plan 2001 – 2005. This trunk road also serves a wide area (AH7 of which the length within Tajikistan is 497 km) under the Asian Highway Initiative. The road was originally constructed in the 1980's during the former Soviet period and has much deteriorated after service for more than 20 years. However, rehabilitation of the section between Dushanbe and Kurgan Tyube (93 km) was completed in August, 2007 with the assistance of the ADB while the construction of a new bridge at the border with Afghanistan was also completed in August, 2007 with US assistance. Moreover, the section between this border bridge and the ending point of the target section of the Project is the subject of the Dusti – Nizhniy Pyandzh Road Rehabilitation Project which is being implemented with Japanese grant aid. The completion of all of these projects will enable the transportation of various goods, including those for humanitarian aid for Afghanistan, and the development of local agriculture and tourism is expected to take place due to the enlivened physical distribution not only between Tajikistan and Afghanistan but also throughout central Asia and the increased transportation of agricultural products and people.

However, the 59.9 km section between Kurgan Tyube and Dusti of this trunk road has not yet undergone any fundamental rehabilitation (repaving, etc.) to rectify the current state of advanced deterioration and damage despite the implementation of such routine maintenance work as pothole repair with the limited budget since its original construction during the former Soviet period as other sections of the same road. Moreover, there is no concrete plan for its rehabilitation. The completion of the border bridge and the advancement of the rehabilitation of neighbouring sections have now made the rehabilitation of this 59.9 km section an urgent necessity to enable International Trunk Road No. 11 to fully perform its proper functions. Against this background, the Government of Tajikistan made a request to the Government of Japan for the provision of grant aid for the rehabilitation of this 59.9 km road section and the Japan International Cooperation Agency (JICA) conducted the Preliminary Study in response to this request.

Having examined the target road, the Preliminary Study Team confirmed that an advanced state of deterioration, including uneven, peeling and/or cracked road pavement and the deterioration of 13 small road bridges, is evident along the entire route and that many traffic accidents are caused by the poor condition of the road surface. The traffic analysis established that 3,856 vehicles (converted to the PCU and a 12 hour period) use the road every day. With the rehabilitation of the road between Dusti and Nizhniy Pyandzh towards the border with Afghanistan, it was easily judged that the requested section of the trunk road for rehabilitation will become a major bottleneck due to an increase of the traffic. Accordingly, the urgency and necessity for the rehabilitation of the target road (between Kurgan Tyube and Dusti) were recognised.

The Preliminary Study also confirmed that the relocation of local residents will be unnecessary as the right of way (ROW) is secured along the entire route and that there will not be any adverse impacts on wildlife and the ecosystem because of the nature of the proposed work (rehabilitation of the existing road).

Based on these findings, the Government of Japan examined the suitable contents of the Project and the scope of assistance under Japan's grant aid scheme and decided to conduct the Basic Design Study for the requested section (approximately 57 km) in view of the fact that the Project is critical to secure the regional as well as wide area transport network in Tajikistan.

(3) Outline of the Study Results and Project Contents

Following the decision of the Government of Japan, the JICA dispatched the Basic Design Study Team to Tajikistan for the period from 12th June to 21st July, 2007. This Study Team reconfirmed the background and contents of the request through discussions with the stakeholders in Tajikistan while studying the conditions of the existing road, natural conditions (topography and

geology), traffic volume on the road, road design standards in Tajikistan and other relevant matters. On its return to Japan, the Study Team examined the suitable contents of the Project based on the field survey results and prepared the outline of the Basic Design, i.e. Draft Basic Design. The JICA then dispatched the Mission to Explain the DBD to Tajikistan for the period from 2nd to 14th November, 2007 and the contents of the Basic Design and the undertakings of the Tajikistan side were agreed by the two sides.

Given the fact that serious deterioration is taking place throughout the road structure, i.e. from the foundations to the surface course, along the entire route of the target road, the need for the rehabilitation of the entire road under the Project was reconfirmed and the length of the target road was revised to 59.9 km. In regard to the road category, Category III of the road standards in Tajikistan was employed as in the case of the Preliminary Study stage. In regard to the road alignment, it was decided to, in principle, trace the existing road in order to minimise the need for the relocation of houses and public facilities along the route. The relevant design for the pavement grade reflected the required pavement strength to withstand not only the existing traffic load but also the anticipated increased traffic load after the opening of the Nizhniy Pyandzh Bridge which was completed in August, 2007.

The 14 existing bridges along the route were examined in terms of their structural health and width. It was decided to replace 12 bridges over irrigation channels with a steady flow rate with box culverts as the use of box culverts will substantially reduce the construction cost. At one bridge, only the rehabilitation of the expansion joints is planned as such partial rehabilitation will ensure the full use of this bridge. The remaining one bridge will be removed as it is no longer in use.

Based on the above considerations, the finally planned contents at the Basic Design stage are outlined in the table below.

Planning Item		Contents
Target Section		59.9 km (between Kurgan Tyube and Dusti)
Pavement Structure	Surface	Asphalt concrete surface course (5 cm): carriageways
		Asphalt concrete base course (5 cm): carriageways
		DBST: shoulders
	Sub-grade	Upper sub-grade: 20 cm (size-adjusted crushed stone)
		Lower sub-grade: 4 – 24 cm (high quality local materials; the thickness of the existing pavement for re-use is separately accounted for)
Road Width		Carriageways: 7.0 m (3.5 m x 2)
		Shoulders: 2.5 m each
Rehabilitation of Cross-Drainage Structures		At 40 sites
Rehabilitation of Bridges		At 14 existing bridges (span: 3.3 – 42.0 m) Breakdown of the planned rehabilitation work - Replacement by box culverts: 12 bridges - Removal of the existing bridge: 1 bridge - Partial repair: 1 bridge (repair of the expansion joints and bridge surface pavement)
Other Auxiliary Facilities		Retaining walls, guard posts and road markings, etc.

(4) Implementation Period and Estimated Project Cost

The required period to implement the Project, including the tender process, will be approximately 50 months (9 months for the detailed design and 41 months for the construction work).

(5) Project Implementation and Maintenance Systems

The implementation organization for the Project is the Ministry of Transport and Communication (MOTC). It will be necessary for the Tajikistan side to undertake the relocation of the existing utility facilities (electricity, water, gas, telephone and sewerage), replanting of the existing roadside trees and securing of the land for the temporary yards, etc. As the total cost of these undertakings is equivalent to approximately 3% of the annual budget of the MOTC, no problems are anticipated in regard to the MOTC's budgetary appropriation for the Project.

Meanwhile, the maintenance work following the completion of the rehabilitation work under the Project will consist of ① such routine maintenance as the cleaning of structures, patching of the road surface and repair of the sub-grade and shoulders and ② such periodic maintenance work (every five years) as rehabilitation of the sub-grade, overlaying and the repair of structures. As the average annual maintenance cost to conduct all the work is equivalent to some 1.1% of the annual budget of the MOTC, the allocation of the necessary funding to meet this cost should not prove difficult for the MOTC.

(6) Verification of the Relevance of the Project

The implementation of the Project is expected to achieve the direct as well as indirect effects described below. The Project will benefit the entire population of Tajikistan (6.62 million).

[Direct Effects]

① The improved travellability and smooth traffic will increase the mean safe travelling speed on the route (excluding urban areas) from the present 30 km/hr or so to 73 km/hr and from the present 20 km/hr or so to 40 km/hr in urban areas.

② The front view (sight distance) when driving will improve from the current 10 m or so at weaving section to 140 m.

③ The introduction of proper shoulders will separate vehicle traffic from pedestrians and cyclists, improving the safety of the road in question.

[Indirect Effects]

① The shortened travelling time will reduce the transportation cost of agricultural products.

② The improved road conditions will contribute to an increase of the volume of inter-regional physical distribution.

③ The road will perform its function as a trunk road serving a wide area, prompting physical distribution and human traffic and vitalising socioeconomic activities.

④ The improved reliability of the road in terms of smooth travellability and the absence of road closures will contribute to regional development, rectification of the regional gap, expansion of the market area and improvement of the access to health care and educational facilities.

The Project is expected to have the significant effects described above through its linkage with Dushanbe – Kurgan Tyube Road rehabilitated by the Asian Development Bank (ADB), the border bridge construction project implemented with US assistance and the ongoing road rehabilitation project with Japanese grant aid featuring the neighbouring section of the target road. As the rehabilitation of the target road will enable its early functioning as a trunk road serving a wide area with its resulting contribution to the lives of local residents in general, the relevance of the Project vis-à-vis the spirit of the grant aid scheme of the Government of Japan is verified.

(7) Important Points and Recommendations

While it is believed that the Tajikistan side has sufficient manpower and funding for the routine maintenance of the rehabilitated road and others under the Project, there is a shortage of equipment to conduct more substantial maintenance work, including overlaying, which will be periodically required. The consolidation of the maintenance equipment/machinery in possession to establish a system which is capable of periodic maintenance without difficulty poses a future challenge for the Tajikistan side to ensure the sustained effects of the Project.

ОБЩИЕ СВЕДЕНИЯ

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(1) Общие сведения о стране

Республика Таджикистан (здесь и далее, как «РТ») обрела независимость от бывшего СССР в 1991 году, и с тех пор страдала от гражданской войны, продолжавшейся 5 лет с 1992 года, а также от серьёзного экономического застоя, последовавшего за ней. В 2000 году были проведены выборы парламента, и процесс замирения, в принципе, завершился, но страна переживает трудности хронического дефицита государственного бюджета, роста безработицы и т.п.

В Таджикистан, в котором 93 % национальных земель приходится на гористый рельеф, большинство товарного обращения и торговых связей с сопредельными странами зависит от дорожных поставок. Дорожные магистрали, идущие в соседние страны из столицы Душанбе, других основных городов, являются основным фундаментом экономики Таджикистана. Однако, большинство этих магистральных дорог было построено в советское время, и остающиеся их повреждения, вызванные гражданской войной после обретения независимости и течением времени, физический износ являются большим фактором, препятствующим оживлению экономики РТ. В этих условиях РТ находится в состоянии, когда страна для осуществления планового оснащения инфраструктуры почти полностью зависит от помощи зарубежных стран по причине хронического дефицита государственного бюджета, несмотря на то, что РТ разрабатывает каждые 5 лет «долгосрочные планы развития транспорта» и продвигает преимущественное оснащение сети магистральных дорог.

(2) Обстоятельства, предыстория и общие сведения по запрошенному проекту

Основная магистраль (международная трасса №11, бывшая 384-я государственная дорога), связывающая столицы РТ и соседнего Афганистана, являясь дорогой преимущественного технического оснащения по «Долгосрочному плану транспортного развития на 2001-2005 годы», стала играть роль также и в качестве региональной трассы, определённой в концепции азиатских скоростных дорог (АН7: протяжённость по территории РТ – 497 км). Дорога на целевом участке была построена в советское время в 1980-е годы, и в настоящее время, по прошествии более 20 лет, физически сильно износилась. Реконструкция части дороги на 93 км участке Душанбе - Курган-Тюбе, примыкающей к участку по данному проекту, была завершена по проекту АБР в августе 2007 года. Кроме того, в августе 2007 года за счёт помощи США было завершено строительство моста на границе с Афганистаном. Также, между конечной точкой по данному проекту и пограничным мостом, построенным США, за счёт средств японского гранта был начат «Проект

реконструкции дороги на участке Дусти – Нижно-Пянж». После завершения этих проектов станет возможной транспортировка различных материалов, включающая гуманитарную помощь Афганистану, ожидается оживление товарного сообщения, не только между двумя странами, но также и между смежными регионами Центральной Азии, ожидается развитие сельского хозяйства и туризма, вызванного увеличением объёмов поставок с/х продукции и пассажирских перевозок.

Однако на 59,9 км участке Курган-Тюбе – Дусти, занимающем часть участка вышеуказанной главной трассы, не осуществляется полномасштабная реконструкция (переукладка покрытия и т.п.), отсутствует перспектива планов реконструкции дороги. Хотя на ней, после окончания её строительства, как и на других трассах, в условиях ограниченного бюджета проводился текущий ремонт по ремонту выбоин. Однако вместе с завершением строительства пограничного моста, дальнейшего улучшения состояния смежных участков, в целях проявления функциональности 11-й международной трассы в целом, потребуется осуществление срочных мер путём реконструкции целевого участка. В таких вот условиях правительство РТ запросило у Японии предоставление гранта на реконструкцию дороги на вышеуказанном участке, и в октябре 2006 года было проведено предварительное изучение проекта по линии «Джайка» (независимого административного лица «Японское агентство международного сотрудничества»).

В результате обследования целевого участка было установлено, что на всём протяжении запрошенного по проекту участка дороги наблюдается сильный физический износ: вздутия и отслоения покрытий, трещины и т.п., сильно изношены балки малых мостов (13 точек) на участке, подтверждено было также частое возникновение ДТП по причине плохого качества дорожного полотна. Кроме того, в результате обследования интенсивности транспортного потока было установлено, что интенсивность движения составляет уже 3.856 единиц в сутки (в пересчёте на пассажирский транспорт). Легко было понять, что данный целевой участок станет слабым местом соответствующей трассы по причине ещё большего увеличения интенсивности движения транспорта после завершения реконструкции дороги на участке Нижно-Пянж со стороны афганской границы и до Дусти, была признана срочность и необходимость реконструкции целевой дороги.

Кроме того, на всём протяжении обследованного участка обеспечивается полоса отчуждения (полоса отвода), и было установлено, что не возникнет перемещений жителей, и не возникнет влияния на фауну и биосферу в результате реконструкции существующей дороги.

Основываясь на вышеизложенных результатах, правительство Японии в результате рассмотрения содержания и объёма помощи соответствующего проекта, в качестве безвозмездной помощи, приняло решение провести изучение базовой концепции в отношении запрошенного участка дороги (примерно 57 км), учитывая, что этот проект необходим для обеспечения транспортного движения в регионах РТ и внутри региональной транспортной сети.

(3) Общие сведения о результатах изучения, а также содержание проекта

В таких условиях «Джайка» в период с 12 июня по 21 июля 2007 года направила в РТ группу изучения базовой концепции. Группа изучения ещё раз уточнила обстоятельства и содержание просьбы в ходе обсуждений с имеющими отношение лицами РТ, вместе с тем, обследовала состояние имеющейся дороги, изучила естественные условия (рельеф, характер почв), состояние точек строительства, включая интенсивность движения, а также изучила нормы дорожного проектирования в РТ. По возвращении в Японию группа на основе результатов обследования рассмотрела содержание соответствующих работ и подготовила краткое описание базовой концепции. После реализации базовой концепции, в период со 2-го по 14-е ноября в РТ была направлена группа по даче разъяснений относительно краткого содержания базовой концепции, были обсуждены, уточнены и согласованы пункты ответственности РТ.

Повторно была подтверждена необходимость реконструкции дороги по данному проекту на всём её протяжении, учитывая, что целевая дорога по всей её длине, от подстилающего основания и до слоя покрытия, находится в состоянии серьёзного износа. Было принято решение взять дорогу на всём её протяжёнии (59,9 км), в качестве объекта реализации по данному проекту. Что касается категории дороги, то, как уже было уточнено в ходе предварительного изучения, применили 3-ю категорию дорог по классификации РТ. Взяли за принцип, что линия дороги будет повторять контуры существующей, и внимание уделялось тому, чтобы предельно не возникал перенос придорожных жилых домов, общественных объектов и т.п. Кроме того, что касается покрытия, то была исследована нагрузка, способная выдержать существующую и соответствующую интенсивности движения, поскольку прогнозируется ещё большее усиление нагрузки после того, как для движения был открыт мост Нижно-Пянж, строительство которого было завершено в августе 2007 года.

12 среди 14 мостов, имеющихся на целевом участке дороги, решено переуложить трубами прямоугольного сечения (кульвертами), с использованием которых станет возможным крупное сокращение издержек, поскольку они будут пропускать воду из оросительных каналов, потоки которых сравнительно стабильны, учитывая здоровую конструкцию этих

мостов и устранение дефицита ширины дороги. Кроме того, один мост может быть в полной мере использован посредством частичного его ремонта, поэтому решено принять меры в виде проведения ремонта одного только расширительного устройства. Вместе с тем один мост решено демонтировать по причине того, что он необходимость в его не использовании отсутствует.

Краткое содержание окончательно спланированного проекта, на базе вышеуказанных результатов, приводится в таблице ниже.

Наименования проекта		Содержание проекта
Целевые участки по проекту		59,9 км (участок Курган-Тюбе - Дусти)
Структура покрытия	Укладка слоя износа	Асфальтобетонный слой износа, 5 см (основная магистраль)
		Несущий асфальтобетонный слой, 5 см (основная магистраль)
		Двухслойное асфальтовое покрытие поверхности: двойная битумная поверхностная стандартная обработка (обочины)
	Гравийно-песчаная подготовка	Верхний подстилающий слой 20 см (щебень с контролем размера)
		Нижний подстилающий слой 4 ~ 24 см (качественное местное сырьё, отдельный расчёт толщины использования имеющегося покрытия данной дороги)
Структура ширины дороги		Ширина основной магистрали Ширина магистрали: 7,0 м (2 полосы × 3,5 м);
		Ширина обочин: стандартная, 2,5 м
Реконструкция поперечных дренажных сооружений		40 точек
Реконструкция мостов		Реконструкция существующих 14 мостов (пролёты 3,3 ~ 42,0 м) Содержание форм реконструкции: - переукладка мостов трубами прямоугольного сечения = 12 мостов - демонтаж существующих мостов = 1 мост (мост, через ликвидированный водный канал) - частичный ремонт = 1 мост (ремонт расширительного устройства и покрытия мостового полотна)
Прочие вспомогательные объекты		Подпорные стенки, предупреждающие дорожные знаки, разметка разделительных линий

(4) Срок строительства по проекту и примерная стоимость работ

В качестве общего срока строительства по данному проекту потребуется примерно 50 месяцев (проектирование реализации – 9 месяцев, период строительства – 41 месяц), включая процессы подготовки и проведения тендера).

(5) Реализация данного проекта, а также система эксплуатации и технического обслуживания.

Исполнительным ведомством по данному проекту является Министерство транспорта и коммуникаций (МТиК). Пункты расходов, которые должна понести таджикская сторона, являются: обеспечение существующих коммунальных услуг (электричество, водоснабжение, газоснабжение, телефонная связь, канализация), перенос придорожных насаждений, выделение земли для склада временного хранения. Расходы, которые потребуются для реализации данных пунктов работ составляют порядка 3 % от годового бюджета МТиК, и, можно считать, что министерство сможет в полной мере взять на себя эти расходы.

С другой стороны, в качестве основных работ по эксплуатации и техническому обслуживанию, которые потребуются после завершения строительства целевой дороги по данному проекту, предполагаются: (1) очистка конструкций, заделывание дорожного покрытия, ремонт дорожного основания и обочин и прочая повседневная работа по эксплуатации и ремонту дороги; (2) периодическая реконструкция дорожного основания, переукладка поверхности, ремонт конструкций (каждые 5 лет) и т.п. Среднегодовые расходы на эксплуатацию и ремонт, необходимые для проведения этих работ, составляют порядка 1,1 % от бюджета МТиК, и можно считать, что оно в полной мере сможет обеспечить эти необходимые расходы.

(6) Исследование целесообразности проекта

Посредством реализации данного проекта ожидается получение следующих непосредственных и косвенных эффектов. Кроме того, количество выгодополучателей, можно считать, составит 6 млн. 662 тыс. человек населения РТ.

(Непосредственный эффект)

a. За счёт обеспечения гладкого движения путём улучшения скоростных характеристик дороги, средняя скорость безопасного движения на участке начальная – конечная точки (кроме городской черты) с 30 км/ч в настоящее время увеличится до 73 км/ч, а средняя скорость движения в городской черте увеличится с 20 км/ч в настоящее время до 40 км/ч.

b. Видимость на дороге во время движения (видимое расстояние) улучшится на существующих волнистых участках с минимальной видимости порядка 10 м до 140 м.

c. Благодаря разделению в зоне обочин движения пешеходов, велосипедистов с движущимся транспортом, повысится безопасность соответствующей дороги.

(Косвенный эффект)

a. Через сокращение времени следования снизится себестоимость перевозок с/х продукции.

b. Через улучшение состояния дороги вносится вклад в увеличение объёмов товарных перевозок между регионами.

c. Проявится функциональность дороги, в качестве региональной магистрали и, благодаря стимулированию товарного обращения и людских связей, оживится социально-экономическая деятельность.

d. Будет внесён вклад в дело регионального развития, в исправление региональных диспропорций, расширение зоны рынка, улучшение доступности медицинских и учебных заведений посредством повышения надёжности дороги через обеспечение гладкого движения за счёт улучшения скоростных характеристик и решение проблем с перекрытием движения.

Целесообразность реализации данного проекта подтверждается тем, что ожидается получение большого эффекта, изложенного выше, посредством координации усилий по проекту реконструкции дороги на участке Душанбе – Курган-Тюбе по линии Азиатского банка развития (АБР), по проекту строительства моста, осуществлённого при помощи США, и, кроме того, по проекту реконструкции дороги за счёт японского гранта, прилегающей к участку, реализуемому в настоящее время по настоящему плану. Вместе с тем, целесообразность реализации данного проекта за счёт гранта Японии подтверждается тем, что в быстрые сроки проявится функциональность дороги в качестве региональной магистрали, что послужит улучшению жизни населения на широкой территории.

(7) Пункты, требующие внимания, а также предложения

Что касается повседневной эксплуатации и ремонта по данному проекту, можно считать, что со стороны РТ обеспечиваются людские и финансовые средства, но, что касается полномасштабного технического обслуживания в виде переукладки полотна, которая будет периодически требоваться, то здесь имеется недостаток строительного оборудования. Для того чтобы сделать эффект от технического оснащения по данному проекту постоянным, обеспечение техникой для технического обслуживания, оснащение системы, которая сможет справляться с задачами периодического ремонта, станут дальнейшими задачами.

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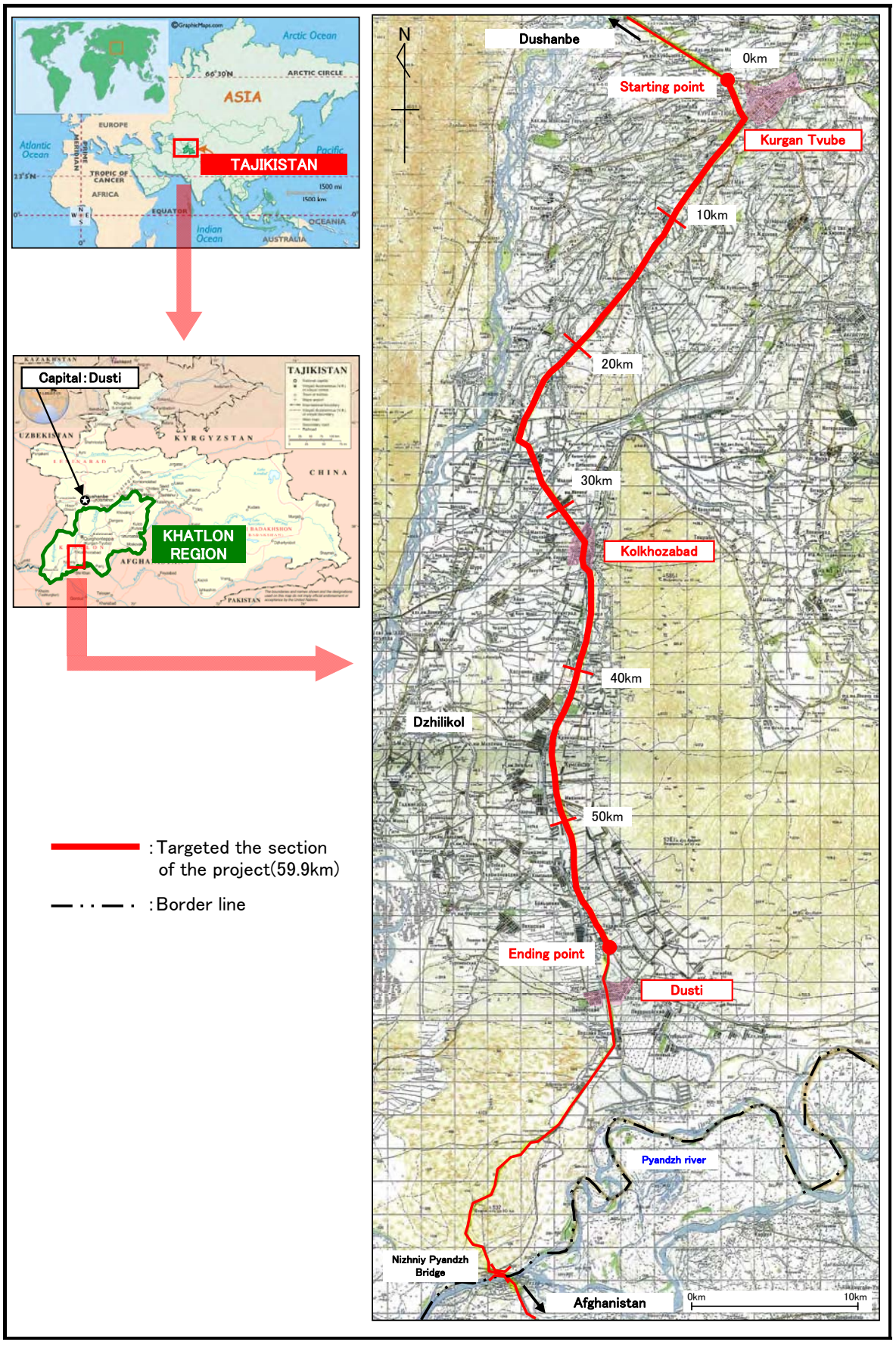

LOCATION MAP

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ABBREVIATIONS

AASHTO	American Association of State Highway and Transport Officials
ADB	Asian Development Bank
AH	Asian Highway
CBR	California Bearing Ration
CIS	Commonwealth of Independent State
DBST	Double Bituminous Surface Treatment
DCP	Dynamic Cone Penetration
EBRD	European Bank for Reconstruction and Development
EIA	Environmental Impact Assessment
EU	European Union
GNI	Gross National Income
GDP	Gross Domestic Product
GNP	Gross National Product
IBRD	International Bank for Reconstruction and Development
IEE	Initial Environmental Examination
IMF	International Monetary Fund
IsDB	Islamic Development Bank
JICA	Japan International Cooperation Agency
M/D	Minutes of Discussion
MOTC	Ministry of Transport and Communication
NGO	Non Government Organization
PCU	Passenger Car Unit
RC	Reinforced Concrete
ROW	Right of Way
SBST	Single Bituminous Surface Treatment
SCEP	State Committee on Environmental Protection and Forest Industry
SCLM	State Committee for Land Management
Somoni	Currency Unit in Tajikistan
TRACECA	Transport Corridor Europe Caucasus Asia
UN	United Nation

CHAPTER 1

BACKGROUND AND HISTORY OF THE PROJECT

CHAPTER 1
BACKGROUND OF THE PROJECT

(1) Background, History and Outline of the Request for Grant Aid Assistance

The target road of the Project between Kurgan Tyube and Dusti forms an important section of the southern route of the road network in Tajikistan which run north, south, east and west from Dushanbe, the capital, providing a vital route to the sea for land-locked Tajikistan. A new bridge across Pyandzh River along the border with Afghanistan has recently been constructed with the assistance of the US government while the road between Dushanbe and Kurgan Tyube has been rehabilitation with the assistance of the Asian Development Bank. Road improvement work is currently taking place between Dusti and Nizhniy Pyandzh with the assistance of the Government of Japan. The planned rehabilitation of the road linking these sections under the Project is considered to be a high priority by the Government of Tajikistan. The completion of all of these projects will contribute to not only economic development in the country but also to the vitalisation of physical distribution using this trunk road serving central Asia in general. However, there is no concrete rehabilitation plan for the 59.9 km section between Kurgan Tyube and Dusti which is part of International Trunk Road No. 11, suggesting the prospect that it could become a bottleneck for the national road network in Tajikistan when the other sections have been rehabilitated. In view of the necessity for the urgent rehabilitation of this section, the Government of Tajikistan made a request to the Government of Japan in January, 2006 for the provision of grant aid for the rehabilitation of this section.

In response to this request, the Japan International Cooperation Agency (JICA) conducted the Preliminary Study in October, 2006. Having examined the target road, the Preliminary Study Team confirmed that an advanced state of deterioration, including uneven, peeling and/or cracked road pavement and the deterioration of 13 small road bridges, is evident along the entire route and that many traffic accidents are caused by the poor condition of the road surface. The traffic analysis established that 3,856 vehicles (converted to the PCU and a 12 hour period) use the road every day. With the rehabilitation of the road between Dusti and Nizhniy Pyandzh towards the border with Afghanistan, it was easily judged that the requested section of the trunk road for rehabilitation will become a major bottleneck due to an increase of the traffic. Accordingly, the urgency and necessity for the rehabilitation of the target road (between Kurgan Tyube and Dusti) were recognised.

(2) Meteorological Conditions

1) Outline

Tajikistan has a national land area of 143,100 km^2 which is approximately 40% of the land area of Japan. 93% of this land area is mountainous and includes 3,000 m class mountains. Plains only exist in part of the northern region and south-western region. The target road between Kurgan Tyube and Dusti is located on a south-western plain which is the country's centre for cotton growing. The area experienced the harshest battle during the civil war which lasted for five years from 1992 and some recovery from its impoverished state in the post-civil war area can now be observed.

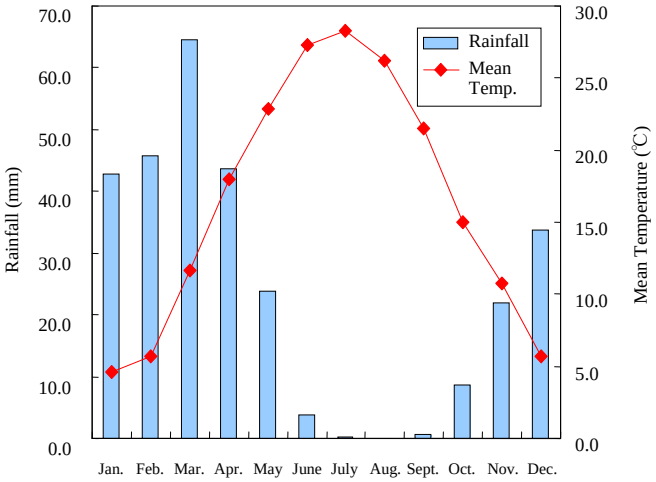


Fig. 1-1 Temperature and Rainfall in Tajikistan

While Tajikistan generally has a continental climate, it considerably differs depending on the altitude. The climate at the south-western plain where the project area is located is characterised by large temperature differences between summer and winter and between day and night. In summer, the temperature exceeds 40°C while dropping to below zero for approximately one month in winter. Strong, dusty gusts lasting for 5 – 10 days occur from June to October. The annual rainfall is as low as some 300 mm, some 90% of which is observed from November to May. Snow falls in winter. The construction plan for the Project will take these meteorological characteristics of the project area into full consideration.

2) Design Discharge and Water Level

The main existing water channels which the target road currently runs across are managed as irrigation channels and their design discharge and water level are controlled by the competent agency (Ministry of Water Resources). The design discharge and water level obtained from the Ministry of Water Resources are shown in Table 1-1.

Table 1-1 Design Discharge and Water Level at Existing Bridge Sites

No.	Name of Irrigation Channel	Design Water Level (m)								Design Discharge (m^3/sec)							
		Annual		Mar. – May		Jun. – Aug.		Sept. – Nov.		Annual		Mar. – May		Jun. – Aug.		Sept. – Nov.	
		Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean	Max.	Mean
Bokhtar																	
1	Beshkappa	1,70	1,35	1,70	1,25	1,70	1,50	1,40	1,30	7,0	3,5	5,0	3,0	7,0	5,0	3,5	2,5
2	Juiber	3,6	2,50	3,0	2,4	3,6	3,0	2,3	2,0	30,0	20,0	22,0	18,0	30,0	27,0	20,0	15,0
3	KDS-V-7-29	1,8	1,5	1,7	1,4	1,8	1,7	1,6	1,4	2,8	1,4	2,0	1,2	2,8	1,6	2,2	1,4
4	KDS-V-7	1,6	1,4	1,5	1,3	1,6	1,6	1,3	1,3	3,0	1,5	2,0	1,2	3,0	2,0	2,0	1,3
5	YK-RC	1,5	1,3	1,3	1,3	1,5	1,5	1,1	1,1	8,0	6,0	6,0	5,0	8,0	8,0	5,0	4,0
Kolkhozabad																	
6	V-21	0,55	0,3	0,55	0,25	0,55	0,45	0,40	0,35	0,25	0,18	0,2	0,15	0,4	0,3	0,15	0,10
7	Obi Shur	2,20	1,60	2,20	1,5	2,20	1,80	1,60	1,50	41,0	39,0	45,0	42,0	38,0	37,0	40,0	38,0
8	KDS	1,47	1,17	1,47	1,15	1,47	1,35	1,15	1,00	0,40	0,18	0,30	0,20	0,40	0,25	0,20	0,10
9	KDS Vintovoi	0,72	0,53	0,72	0,51	0,72	0,65	0,52	0,42	0,20	0,10	0,15	0,10	0,20	0,15	0,15	0,05
10	Jilikul	1,70	1,35	1,70	1,25	1,70	1,50	1,40	1,30	21,0	12,6	14,0	11,0	21,0	17,0	16,0	10,0
11	Qumsangir	2,80	2,37	2,80	2,30	2,80	2,50	2,40	2,30	30,0	20,0	23,0	17,0	30,0	25,0	25,0	18,0
12	V-2	1,45	1,32	1,35	1,30	1,45	1,45	1,20	1,20	2,8	1,2	1,8	1,0	2,8	1,4	1,2	1,2
13	Abandoned Channel	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Qumsangir																	
14	R-2	1,7	1,43	1,7	1,5	1,7	1,5	1,5	1,3	12,3	8,0	7,0	5,0	12,3	8,0	5,0	3,5

Source: Ministry of Water Resources, Kurgan Tyube, July, 2007

When the design discharge at each bridge site is compared to the permissible discharge and permissible water level based on the cross-section of each existing bridge, the clearance under the girders still has room for extra discharge. There is no information or any records that the water level has reached a dangerous level for any of the existing irrigation channels. Accordingly, the clearance under the girders of the existing bridges will be adopted for the planned reference height for new structures as part of the rehabilitation work for the existing bridges.

(3) Social and Environmental Considerations

As part of the Preliminary Study which was conducted in October, 2006 prior to the Basic Design Study, a site survey and IEE (initial environmental evaluation) were conducted in collaboration with the counterpart engineers of the assumed project implementation organization and the following matters were confirmed.

- The right of way (hereinafter referred to as “ROW”) for a Category III road is secured along the entire section, making the non-voluntary relocation of residents unnecessary.
- As the Project aims at the rehabilitation of an existing road and does not involve a substantial new route, the impacts of the work on animals and plants will be small.

- As facilities, including houses, which require quiet surroundings are located some distance from the road, any impact of the Project on these facilities will be minimal. In addition, measures to reduce the work noise can be employed.

For the implementation of the Project in the coming years, it will be necessary for the Tajikistan side to undergo a procedure similar to that for the ongoing Dusti-Nizhniy Pyandzh Road Improvement Project to pass the design review, including the obtaining of environmental permission from the National Construction Commission. In view of this, the details of such procedure and the necessary work and period to complete the design review were checked with the Tajikistan side and the following clarifications were made.

- The design documents for the Project will be forwarded for the design review following the completion of the first step, i.e. prior meetings with the relevant authorities (Transport Police and Ministry of Water Resources, etc.)
- Approximately two months will be required to complete the design review.

The progress of the above meetings and design review will be monitored as necessary in the course of the Basic Design Study.

CHAPTER 2

CONTENTS OF THE PROJECT

CHAPTER 2
CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

(1) Higher Goal and Project Goal

Since independence, the Government of Tajikistan has formulated a "long-term transport development plan" every five years to improve the trunk road network in order to systematically develop the transport infrastructure. The target road of the Project is one of the priority sections listed in such long-term plan (2001 – 2005). Meanwhile, the MOTC, the assumed implementation organization for the Project, has formulated the National Investment and Technology Programme 2005 – 2007, having identified an urgent need to improve the efficiency of cargo and passenger transportation through the development of the road and railway networks to facilitate the economic growth of the country.

The target road section of the Project, i.e. between Kurgan Tyube and Dusti, is part of a 497 km long section of the Asian Highway No. 7 (AH7) in Tajikistan and, therefore, commands important international status. Part of this road (a 93 km section between Dushanbe and Kurgan Tyube) has been fully rehabilitated with the assistance of the ADB. Meanwhile, the work to construct a new bridge across the border with Afghanistan at Nizhniy Pyandzh was completed in August, 2007 with US assistance and the work to construct customs facilities is currently in progress. In addition, road rehabilitation work is in progress for the section between Dusti and Nizhniy Pyandzh under a Japanese grant aid project. Under these circumstances, the Project aims at securing a reliable transportation route for people and cargo through the rehabilitation of the target section to vitalise human movement and the physical distribution of goods between Tajikistan and such neighbouring countries as Uzbekistan and Afghanistan in particular and central Asia in general in order to facilitate the economic growth of Tajikistan.

(2) Outline of the Project

To achieve the goals described in (1) above, the Project plans the rehabilitation of the 59.9 km long road section between Kurgan Tyube and Dusti.

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policies

(1) Basic Policies

The target road of the Project, i.e. the section between Kurgan Tyube and Dusti, is part of the southern route of the trunk road network in Tajikistan. This southern route is a very important route for Tajikistan as it links Dushanbe with the Indian Ocean via Afghanistan. The rehabilitation of the Dushanbe-Kurgan Tyube section and the construction of a new border bridge between Tajikistan and Afghanistan have so far been completed by other donors while the ongoing rehabilitation of the Dusti-Nizhniy Pyandzh section with Japanese grant aid is scheduled to be completed in March, 2009. However, the target section of the Project which was originally constructed at the same time as those neighbouring sections of which the rehabilitation has either been completed or is in progress has become noticeably uneven and cracked and has no concrete rehabilitation plan, presenting the prospect of this section becoming a major bottleneck for the southern route of the trunk road network unless urgent repair work is conducted. The following basic design policies have been adopted for the Project to rectify the serious flaws of this road section in order to ensure smooth and safe traffic flow.

Target Section

Given the state of severely progressive deterioration throughout the road structure, ranging from the foundations to the surface course, along the entire route, rehabilitation work will be necessary for the entire road. The original request was for a 57 km section between Kurgan Tyube and Dusti. This figure has now been increased to 59.9 km based on the detailed survey of the route under the Basic Design Study and examination of the details of the likely Project.

Design Standards

For the design of the rehabilitation of the target road, the road construction standards (SNIP) adopted by the Ministry of Construction of the former Soviet Union which was responsible for road projects in the former Soviet Union are referred to as these standards are still used in Tajikistan today. However, reference is made where necessary to US standards (AASHTO) and others for the purpose of better design and planning.

Road Standards

The road standards for Category III roads (standards for local trunk roads) in Tajikistan which were adopted for the existing road are used as the road standards. In regard to the road alignment, it has been decided, in principle, to trace the existing road in order to minimise the need for the

relocation of houses and public facilities along the route. In consideration of the gently undulating topography along the route, 80 km/hr for a Category III road is adopted as the design speed. Accordingly, the minimum curve radium on a flat surface and the maximum vertical slope are set at 230 m and 5.0% respectively.

Paving Plan

For the planning of the paving work, determination of the design load is necessary. In consideration of the assumed traffic volume of 1,000 vehicles a day at Nizhniy Pyandzh Bridge over the Afghanistan border, the 16.5 – 20.3 million axle bearing class (local trunk road level in Japan) is used as the converted standard axle weight (converted to 8.2 ton axle) for the planning of the pavement strength.

Structure Plan

For the rehabilitation work of major structures, 14 bridges and 77 culverts along the route were examined. Only one bridge was found to be structurally sound with a sufficient width even though this bridge still requires repair. Other bridges were found to have structural problems and/or insufficient width and these bridges are located throughout the route. A way of rehabilitating these bridges under the Project was examined from the viewpoint of solving the problems of structural soundness and insufficient width and it has been decided to replace 12 bridges with box culverts based on comprehensive analysis of the required cross-section to allow the present level of discharge, geological and topographical conditions and workability, etc. This decision also reflects the fact that the use of box culverts will enable a substantial reduction of the rehabilitation cost. For the rehabilitation of the existing culverts (cross-drainage structures), it has been decided to extend the existing structures in view of the structural soundness and on-site conditions of the existing culverts. The existing drainage system was taken into consideration in reaching this decision.

(2) Policies Regarding the Natural Conditions

The road plan, road drainage facility plan, irrigation channel plan and construction plan will reflect the meteorological and hydrological conditions of the project area. The topographical and geological conditions will be incorporated in the road plan, structure plan and construction plan. The concrete natural conditions to be dealt with are explained next.

1) Meteorological Conditions

As the annual rainfall in the project area is as low as some 300 mm, no special considerations are required in regard to rainfall. In regard to temperature, the period with the lowest temperature in the project area is generally from late December to late January

although the daytime is relatively warm compared to the night time. Snow falls on several days a year but there is no lasting snow cover. In view of these facts, it is believed that the design issues to be considered in connection with the meteorological conditions are the asphalt paving work and concrete placing method in the cold period from December to January.

2) Hydrological Conditions

As part of the field survey, an inventory survey was conducted in regard to the existing channel-crossing road bridges, small drainage facilities crossing the road and roadside gutters. In addition to an interview at the Ministry of Water Resources,, the state of erosion along the road due to rainwater was checked in view of the planning of adequate drainage facilities. The present conditions of the subject structures of the inventory survey are described next.

① Existing channel-crossing road bridges

When the design discharge at each bridge site obtained from the Ministry of Water Resources is compared to the permissible discharge based on the cross-section of each existing bridge, the clearance under the girders still has room for extra discharge. There is no information or any records that the water level has reached a dangerous level for any of the existing irrigation channels. Accordingly, the clearance under the girders of the existing bridges will be adopted for the planned reference height for new structures as part of the rehabilitation work for the existing bridges.

② Small drainage facilities crossing the road

The existing small drainage facilities crossing the road are used as irrigation channels serving cultivated land on both sides of the road. No serious damage to the drainage facilities proper has been found and it will be sufficient for the project design to extend the existing structures in those places where such extension is required. However, urgent maintenance work by the MOTC is required as the over-growth of grass and sedimentation are causing poor drainage in many places.

③ Roadside gutters

Many roadside gutters are being used as makeshift irrigation channels in many places. Apart from these gutters, pre-cast concrete channels have been installed in some places for exclusive use for irrigation. During the busy farming season from April to October, the level of the discharge in the irrigation channels increases and leakage through the joints or damaged sections and overflow from the crown result in standing water in the

roadside gutters. Although the irrigation channels and pumps, etc. are owned by the public authorities, their maintenance is inadequate. It is, therefore, necessary to check and review the installation standards for roadside gutters adopted by the MOTC and Ministry of Water Resources.

3) Topography and Geology of the Construction Sites

The geology of the project area principally consists of alternative layers of sandy soil and silt. Relatively compacted sandy soil with the partial distribution of a gravel layer is found below GL -5.0 m. A boring survey was conducted at 12 (total of 14 points) of the 14 existing bridge sites because of the planned bridge replacement at these 12 sites. This boring survey aimed at checking the supporting layer of the bridge structure and found that the supporting layer consisted of either sandy soil or terrace gravel at a depth of some 5 – 17 m from the ground surface. It was also found that spread foundations could be used to support the box culverts used to construct a replacement bridge in the light of the bearing power established by the geological survey except at the No. 11 and No. 12 bridges. In the case of the No. 11 and No. 12 bridges, spread foundations can be used if the soil for a depth of 2 m below the box culverts is replaced with good soil.

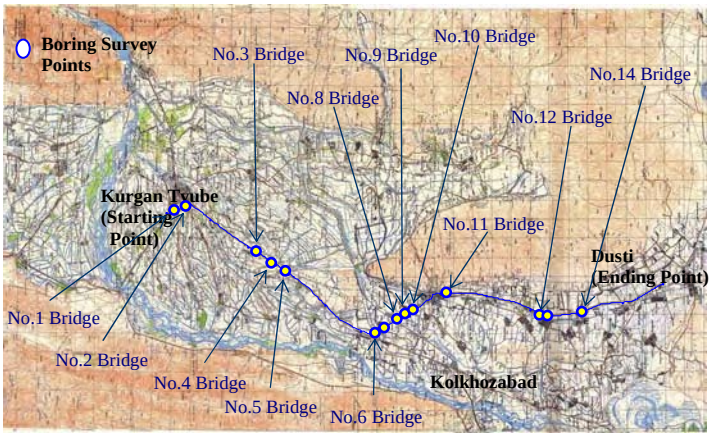


Fig. 2-1 Boring Survey Points

(3) Policies Regarding the Socioeconomic Conditions

1) Land Use Along the Route

There are three principal urban areas, i.e. Kurgan Tyube at the starting point, Kolkhozabad near the halfway point and Dusti at the ending point, along the Kurgan Tyube-Dusti road and a number of hamlets between these urban areas. Sections other than those in urban areas are lined by cultivated fields, mainly cotton growing fields. Idle fields are used for the grazing of cattle and sheep. The principal local industry is agriculture and many carts and bicycles used for farming and the transportation of cargo use the target road as a community

road. Because of such use, the design of the road shoulders under the Project must take road use by slow moving vehicles as well as fast moving vehicles into consideration. Many agricultural facilities (irrigation channel and water gates) and public utilities (electricity, water, gas, telephone and sewerage) exist at the side of the road and it will be necessary for the Tajikistan side to bear the cost of the relocation or removal of these facilities as necessitated by the planned road rehabilitation work under the Project.

2) Social and Environmental Considerations

As part of the Preliminary Study which was conducted in October, 2006 prior to the Basic Design Study, a site survey and IEE (initial environmental evaluation) were conducted in collaboration with the counterpart engineers of the assumed project implementation organization and the following matters were confirmed.

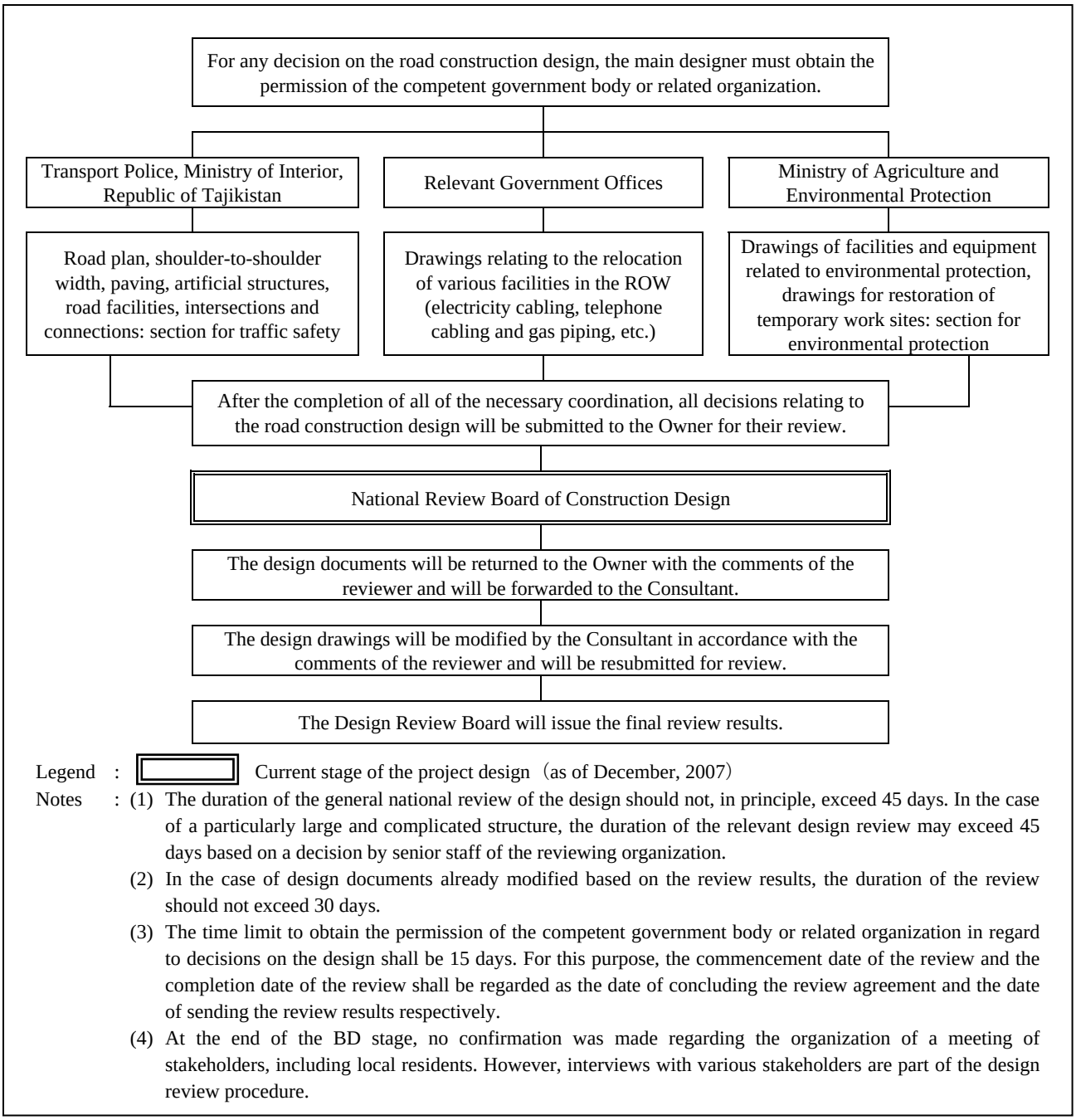
- The right of way (hereinafter referred to as "ROW") for a Category III road is secured along the entire section, making the non-voluntary relocation of residents unnecessary.
- As the Project aims at the rehabilitation of an existing road and does not involve a substantial new route, the impacts of the work on animals and plants will be small.
- As facilities, including houses, which require quiet surroundings are located some distance from the road, any impact of the Project on these facilities will be minimal. In addition, measures to reduce the work noise can be employed.

Even though a sufficient width for the ROW, i.e. 50 m for urban sections and 100 m for other sections, based on existing roads has been secured by a Presidential Decree promulgated in May, 2006 for Class III roads, such as the target road, structures constructed prior to this decree still exist in the ROW. Because the Project aims at the rehabilitation of the existing road, the existence of thee structures has been taken into proper consideration in the process of the Basic Design.

For the implementation of the Project in the coming years, it will be necessary for the Tajikistan side to undergo a procedure similar to that for the ongoing Dusti-Nizhniy Pyandzh Road Improvement Project to pass the design review, including the obtaining of environmental permission from the National Construction Commission. In view of this, the details of such procedure and the necessary work and period to complete the design review were checked with the Tajikistan side and the following clarifications were made.

- The design documents for the Project will be forwarded for the design review following the completion of the first step, i.e. prior meetings with the relevant authorities (Transport Police and Ministry of Water Resources, etc.)
- Approximately two months will be required to complete the design review.

The progress of the above meetings and design review will be monitored as necessary in the course of the Basic Design Study. The required coordination related to the design review and the design review implementation procedure are shown in Fig. 2-2.



Legend : Current stage of the project design（as of December, 2007）

Notes : (1) The duration of the general national review of the design should not, in principle, exceed 45 days. In the case of a particularly large and complicated structure, the duration of the relevant design review may exceed 45 days based on a decision by senior staff of the reviewing organization.

(2) In the case of design documents already modified based on the review results, the duration of the review should not exceed 30 days.

(3) The time limit to obtain the permission of the competent government body or related organization in regard to decisions on the design shall be 15 days. For this purpose, the commencement date of the review and the completion date of the review shall be regarded as the date of concluding the review agreement and the date of sending the review results respectively.

(4) At the end of the BD stage, no confirmation was made regarding the organization of a meeting of stakeholders, including local residents. However, interviews with various stakeholders are part of the design review procedure.

Fig. 2-2 Design Review Procedure

As part of the necessary consideration for the implementation of road rehabilitation work, the IEE survey jointly conducted by the Japanese and Tajikistan sides at the time of the Preliminary Survey identified items ranked B (some impacts are likely to occur) or higher. These items were reviewed in the present study and measures to reduce their environmental load as a result of the construction work were examined (see Table 2-1). It will be necessary to monitor these items during the project implementation period along with the careful planning and management of the construction work.

Table 2-1 Environmental Load of the Project and Reduction Measures

Item	Key Points	Reduction Measures	Monitoring Items		
			Prior to the Work	During the Work	After Re-Opening
Air Pollution	Exhaust from construction machinery and dust from the construction work	No idling of the engines; thorough maintenance of the machinery; watering to control dust	Confirmation of the equipment to be used	Check of the implementation state of the work	-
Water Pollution	Water pollution due to the construction of bridges and cross-drainage structures	Prevention of the outflow of dirty water using temporary closing works, etc.	Confirmation of the construction method	Check of the implementation state of the work	Check at the time of the defect inspection
Soil Contamination and Waste	Waste asphalt and surplus soil; daily waste from the base camp	Examination of a method to re-use the existing asphalt pavement; disposal at a designated site without fail	Confirmation of the construction method	Check of the implementation state of the work	-
Noise and Vibration	Noise and vibration accompanying the construction work	Non-use of a construction method causing high levels of noise and vibration	Confirmation of the construction method	Check of the implementation state of the work	-
Bottom Deposit	Adverse impacts of discharged sediment on bottom deposit	Excavation work using temporary closing works; prevention of sediment discharge by stabilizing the slope surface	Confirmation of the construction method	Check of the implementation state of the work	-
Water Use	Disruption to water use due to changes of the courses of river and irrigation channels	Installation of suitable crossing facilities at the time of the construction work	Confirmation of the construction method	Check of the implementation state of the work	-
Accidents	Accidents involving road users following the commencement of the construction work	Appropriate arrangements for the work sites and detours; deployment of traffic controllers; clear indication of the work sites	Confirmation of the work implementation plan	Check of the implementation state of the work; checking of the MOTC's information	Interviews at the time of the defect inspection
Local Economy, Including Employment and Livelihood	Temporary relocation of street stalls during the work period	Examination of alternative sites; ensured access to street stalls	Confirmation of the explanatory meeting to be held by the regional office	Check in accordance with the work progress	Check at the time of the defect inspection
Infectious Diseases, such as HIV/AIDS	Impacts of the inflow of workers and medical waste from the base camp, etc.	Education of workers; proper treatment of waste	Confirmation of the work implementation system	Check of the state of implementation	-

(4) Policies Regarding the Local Construction Industry and Procurement Conditions

1) Policies Regarding the Local Construction Industry

The local law relating to the employment of local staff for the Project is the Labour Law which was enforced in June, 1997. Accordingly, the minimum wage by type of job and working hours, etc. under the Project will follow the relevant provisions of the said law.

Road and bridge improvement projects have been implemented in Tajikistan in recent years with the assistance of the JICA, ADB, ISDB, Government of Iran and USAID, etc. and foreign civil engineering companies have established local offices in Tajikistan to proceed with these projects. As local civil engineering/construction companies have been used as subcontractors for these projects, it is possible for the Japanese contractor for the Project to employ the required workers in Tajikistan.

2) Construction Material Procurement Policies

The procurement of such main construction materials as aggregate for the roadbed, cement and aggregate for concrete and timber is possible in Tajikistan. In the case of crushed stone for road construction, if the production of aggregate through direct quarrying is assumed, the possession of quarrying rights will be required. However, the procedure to obtain such rights usually requires several months to complete. In view of the construction schedule and volume of use for the Project, it is more realistic to use a local crushed stone producer or construction company for the procurement of crushed stone. Any permit relating to blasting work will be obtained through a local company if such a permit is necessary.

It may be the case that crushed stone of which the quality is good enough for use as aggregate for paving and concrete must be procured from a site located some 100 – 150 km away from the project sites, making the unit cost of the crushed stone/aggregate relatively expensive. The candidate sites for aggregate procurement are listed in Table 2-2.

Table 2-2 Candidate Sites for Aggregate Procurement

Place	Location	Remarks
Sanband	Some 17 km east of Kurgan Tyube Some 47 km northeast of Kolkhozabad	Supplied paving aggregate for the ADB project (Dushanbe-Kurgan Tyube Road)
Vakhsh	Some 20 km southeast of Kurgan Tyube Some 35 km northeast of Kolkhozabad	If the quality is good enough, crushed stone from Vakhh will be used for the Project because it is the nearest to the project sites.
Kulyab	Some 150 km east of Kurgan Tyube Some 180 km northeast of Kolkhozabad	Supplied paving aggregate for the ADB project (Dangara-Kulyab Road)
Dushanbe	Some 100 km north of Kurgan Tyube	The supply of paving aggregate for the JICA project (Dusti-Nizhniy Pyandzh Road) is under consideration.

In the case of cement, there is currently only one domestic manufacturer and the possible source(s) for cement supply, including from a third country, will be examined taking the supply quality and quantity into full consideration. As the local procurement of such main materials as bitumen and reinforcing bars is difficult, their procurement from neighbouring countries will be considered to ensure a reliable supply, sufficient product quality and economic procurement. Fuel imported from Iran and Russia can be procured in the local market.

3) Construction Machinery Procurement Policies

Most of the construction machinery which can be locally procured is quite old and a long time will be required to obtain spare parts if this machinery breaks down. The procurement of that machinery which is likely to be used for a long time at the construction sites from Japan and/or third countries will, therefore, be considered. In the case of cranes and other machinery of which the use is likely to be for only a short time on each occasion, the principal policy is local procurement.

(5) Policies Regarding the Use of Local Construction Companies

There are several tens of construction companies in Tajikistan which have experience of involvement in trunk road improvement work based on international tender. However, Sangreza, Gyur and Mostootryad are the only local construction companies capable of working as a subcontractor for the planned work (road rehabilitation and bridge replacement) under the Project. As they have rich experience of road rehabilitation and bridge replacement work in Tajikistan, their use as a subcontractor(s) for the Project will be considered.

(6) Policies Regarding the Operation and Maintenance of the New Facilities

The implementation organization for the Project is the MOTC. The MOTC has entrusted the technical work i.e. survey, planning and design, to the Road Design Research Institute which was privatised in 2006. The General Bureau of Road Construction which is directly controlled by the First Deputy Minister will manage matters relating to the construction work. The Road Construction and Maintenance Division of the General Bureau of Road Construction has regional offices which are responsible for matters relating to roads and transport (including public bus transport and others) as well as road maintenance in their respective regions (or cities). Each regional office controls the district maintenance offices (state enterprise for road maintenance), ensuring the maintenance of roads and road-related facilities, such as bridges.

The project area falls under the jurisdiction of the Khatlon Regional Office. The target road section (between Kurgan Tyube and Dusti) runs through three districts of the Khatlon Region and the state enterprises for road maintenance maintain the 15 km section in the Bokhtar District, the 30 km section in the Kolkhozabad District and the 15 km section in the Qumsangir District respectively. These state enterprises also maintain road other than national roads. The total staff strength of the MOTC, including regional offices, is 22,854 (as of December, 2005).

The maintenance budget for national roads is allocated by the Treasury of the Ministry of Finance on application by the MOTC while the maintenance budget for district roads is allocated by local municipalities. Small repair work involving pot holes, etc. is conducted as required. For

large repair work involving overlay, etc., a special budget is supposed to be allocated by the MOTC but the chronic budget shortfall means that such work is not satisfactorily conducted. Moreover, there is a shortage of maintenance equipment. Table 2-3 shows the budget of the MOTC.

Table 2-3 Annual Budget of the MOTC

Unit: million somoni (TJS)

Item	2002	2003	2004	2005	2006
Annual National Budget	540	770	1,030	1,300	1,326
MOTC Budget	18.4 (5.75)	26.7 (8.35)	39.1 (12.22)	44.2 (13.81)	51.5 (16.12)
Road Maintenance Budget of MOTC	3.5 (1.09)	5.0 (1.56)	12.0 (3.75)	18.1 (5.66)	20.9 (6.54)
Budget Growth Rate (%)	-	143	240	151	115

Note: The unit for the figures in brackets is U$ million.

(7) Policies Regarding the Scale and Contents of the Subject Facilities for Assistance

1) Starting and Ending Points of the Project

The starting point of the target road of the Project is the connecting point between Dushanbe-Kurgan Tyube Road which has been rehabilitated by the ADB and Kurgan Tyube-Dusti Road while the ending point is the starting point of Dusti-Nizhniy Pyandzh Road of which the rehabilitation is in progress with Japanese grant aid. The total road length between these two points is approximately 59.9 km.

2) Geometric Structure of the Target Road

The Category III Standards of the Geometric Structure Standards for Roads which were originally introduced during the former Soviet period and which are still used in Tajikistan today will be adopted to determine the geometric structure of the target road of the Project (see Table 2-4).

Table 2-4 Road Category and Geometric Structure Standards in Tajikistan

Road Category	Traffic Volume		Design Speed (km/hr)			No. of Carriageways	Carriageway Width (m)	Shoulder Width (m)
	PCU/day	ADT	Flat Land	Hill	Mountain			
III	2,000-6,000	1,000-3,000	100	80	50	2	3.50	2.50

Source: Road Construction Standards 2.05, 02-85, State Committee of the USSR, 1986

As the target road of the Project runs through gently undulating land along the entire route, a design speed of 80 km/hr for the hill area in Table 2-4 above is adopted. However, the design speed drops to 40 km/hr in urban areas, such as Kolkhozabad, and at major intersections. Based on discussions with the Tajikistan side, a minimum curve radius in urban areas of 30 m has been decided.

Table 2-5 Geometric Structure by Road Type

	Unit	Road Type	
		General	Urban Road/Intersection
Design Speed	km/hr	80 (60)	40
Cross Slope of Carriageway	%	2.0	
Cross Slope of Shoulder	%	4.0	
Minimum Planar Curve Radius	m	230 (120)	50 (30)
Maximum Longitudinal Slope	%	5 (8)	8
Maximum Super-Elevation	%	6	6
Minimum Sight Distance	m	140 (113)	55

Note: The figures in brackets are the smallest values.
Source: Excerpt from the Technical Notes (agreement at the time of the field survey)

3) Existing ROW

A Presidential Decree issued in May, 2006 ensures a ROW width of 50 m in urban areas and 100 m in other areas for Category III roads, primarily featuring existing roads. Because of this decree, there are now new regulations concerning the recommendation of the relocation of existing structures constructed prior to the decree in a ROW and the restriction of the construction of new structures.

4) Existing Bridges and Culverts

① Bridges

There are a total of 14 bridges in the target road section and these bridges can be classified as RC girder bridges, H section girder bridges and steel plate girder bridges. All of the bridges cross an irrigation channel. 12 bridges (bridge length of 3 – 28 m) are old as they were constructed in the 1960's or even earlier. Two bridges (bridge length of 29 m and 42 m) are relatively new as they were constructed in 1985 and 1993. Only one bridge is sound in terms of both the structural health and width even though this bridge still requires partial repair. The other bridges face a problem in terms of the structural health and/or width which fails to meet the relevant Category III standard. The situation is very serious in the case of two bridges (No. 10 and No. 14) to the extent that bridge collapse is not beyond a possibility. The situation of three other bridges (No. 2, No. 5 and No. 13) is almost as bad as that of these two bridges.

Problematic bridges are located along the entire route of the target road. These bridges have been assessed from the viewpoint of the structural soundness and width required for a Category III road as shown in Table 2-6.

Table 2-6 Assessment of the Existing Bridges

No.	Location (km)	Length (m)	Assessment Results		Remarks
			Width	Structure	
1	1 + 000	5.5	○	×	Insufficient width; exposed reinforcing bars; some defective areas
2	2 + 250	26.95	×	×	Insufficient width; exposed reinforcing bars; some defective areas
3	11 + 400	17.41	○	×	Insufficient width; exposed reinforcing bars; some defective areas
4	13 + 600	11.1	○	×	Insufficient width; exposed reinforcing bars; some defective areas
5	14 + 800	12.1	×	×	Insufficient width; exposed reinforcing bars; some defective areas
6	27 + 400	3.3	○	×	Insufficient width; some defective areas; traces of erosion
7	28 + 050	42	○	○	Good condition; damaged joints
8	30 + 100	15.6	×	×	Insufficient width; structural deterioration
9	30 + 700	28.1	×	×	Insufficient width; cracks in the abutments
10	30 + 900	22.3	×	×	Insufficient width; exposed reinforcing bars; some defective areas; serious deterioration overall
11	36 + 200	29.4	×	×	Insufficient width; structural deterioration
12	46 + 800	12.3	×	×	Insufficient width; cracks in the abutments
13	46 + 830	12.85	×	×	Insufficient width; severe rusting; irrigation channel no longer in use
14	52 + 200	18.45	×	×	Insufficient width; exposed reinforcing bars; some defective areas; serious deterioration overall

② Culverts

A culvert (one of three types) crosses the target road at 77 sites. The possibility of extending, partially repairing or replacing the existing structure under the Project has been examined in view of the structural soundness and suitability of the location, etc. of each culvert. In addition, the local drainage system has been checked.

(8) Policies Regarding the Construction Method and Schedule

A suitable construction period under the Project has been examined in view of the large scale of the construction work covering a total road length of 59.9 km while taking the following important points into consideration.

< Important Points >

i. As much of the equipment and machinery will be procured in Japan, careful consideration of the lengthy time of transportation over a long distance from Japan to the project site is necessary.

ii. The bridge replacement work should avoid the flooding season (May – October) for the irrigation channels and should be conducted from November to April when the water level is low.

iii. The concrete placing work and asphalt paving work in mid-winter (December – January) must be conducted with proper temperature control.

iv. As it is likely that the relocation of some public facilities (electricity, water, gas, telephone and sewerage) will be necessary under the Project at the expense of the Tajikistan side, the proper incorporation of the time required for such relocation in the project schedule is necessary.

v. Although the introduction of detours during the construction period is planned to avoid the disruption of normal traffic as much as possible, a one-way traffic system will be introduced at sites where a detour cannot be introduced. Careful attention must be paid to the safety of normal traffic at these sites.

2.2.2 Basic Plan

(1) General

1) Scope and Scale of the Planned Facilities

The request for the Project aims at the rehabilitation of the target road. Although the original request was for the rehabilitation of the existing road with a total length of 57 km, confirmation of the starting and ending points of the target road and the topographical survey have increased the total road length by approximately 3 km, totalling 59.9 km. The analysis and assessment results for the 14 existing bridges show that the entire replacement of 12 bridges, the partial rehabilitation of one bridge and the removal of one bridge will be necessary. In the case of those bridges which will be entirely replaced, it has been decided to employ a box culvert type bridge based on the examination results of the necessary length and width, etc.

2) Outline of the Basic Plan

The examination results of the basic design policies and the standards forming the basis for the design of the various facilities are outlined in Table 2-7 and Table 2-8.

Table 2-7 Outline of the Basic Design Concept for the Project

Planning Item		Contents
Length of Target Road		59.9 km
Pavement Structure	Surface Work	Asphalt concrete surface course: 5 cm (carriageways)
		Asphalt concrete base course: 5 cm (carriageways)
		Double bituminous surface treatment (shoulders)
	Sub-Base Work	Upper sub-base: 20 cm (size-adjusted crusher-run stone)
		Lower sub-base: 4 – 24 cm (good quality local materials; the thickness of the re-used existing lower sub-base is determined separately
Road Width		Carriageway width: 7.0 m (two carriageways x 3.5 m)
		Shoulder width: standard width of 2.5 m on each side
Rehabilitation of Drainage Facilities Crossing the Road		40 sites
Rehabilitation of Bridges		Rehabilitation of 14 existing bridges (length: 3.3 – 42.0 m) Type of planned rehabilitation work: - Replacement of a box culvert bridge = 12 bridges - Removal of the existing bridge = 1 bridge - Partial repair = 1 bridge (repair of the expansion joints and bridge deck pavement)
Other Auxiliary Facilities		Retaining wall work, roadside barrier work and road marking work, etc.

Table 2-8 Reference Standards for the Project Design

	Examination Item	Applicable Standards, etc. for the Item	Remarks
1	Target Road	59.9 km section of International Trunk Road No. 11 (former National Road No. 384) (including the replacement of 12 bridges by box culvert bridges, partial repair of one bridge and removal of one bridge)	The starting point is the connecting point between Dushanbe-Kurgan Tyube Road rehabilitated by the ADB and Kurgan Tyuge-Dusti Road and the ending point is the starting point of Dusti-Nizhniy Pyandzh Road under rehabilitation with Japanese grant aid (on the drawing, Dusti is considered to be the starting point for the work).
2	Road Category	Category III	Based on the road categories used in Tajikistan
3	Topography	Gently undulating land (partly urbanised)	Judged based on the field survey findings
4	Applicable Design Standard: Geometric Structure	The road design standards (SNIP 2.05, 02-85 and 2.07, 01-89) during the Soviet period are taken into consideration. The “Explanation and Application of the Road Construction Ordinance” of Japan and others are applied where necessary.	Priority is given to the standards commonly used in Tajikistan.
5	Alignment	The design speed for the carriageways is 80 km/hr. The design speed for urban areas is 40 km/hr.	Judged based on the field survey findings.
6	Road Width	Carriageway width: 7.0 m (3.5 m x 2) Shoulder width: 2.5 m each side (SNIP 2.07, 01-89)	Category III of the road design standards in Tajikistan
7	Pavement Structure	Based on the AASHTO Guide for Design of Pavement Structures (1993) of the US	The compatibility with the standards applied to connecting roads is taken into consideration.
8	Traffic Type Based on Pavement Design	No. of 18-kit equivalent single axle loads (ESALs) over the design service life	The compatibility with the standards applied to connecting roads is taken into consideration.
9	Design Load for Box Culvert	TL25 load (wheel load of 10 tons) of the Specifications for Highway Bridges of Japan	Judged based on the field survey findings
10	Auxiliary Structures and Road Markings, etc.	Relevant design standards commonly used in Tajikistan	Priority is given to the standards commonly used in Tajikistan.

(2) Facilities Plan

1) Road Plan

① Subject Section for Design

The subject section for the project design is the 59.9 km road section between Kurgan Tyube and Dusti as requested. The standards for Category III roads are used to examine the details of the required work.

② Design Conditions

Design Standards

The design standards in Tajikistan were originally based on the construction standards (SNIP) issued by the Ministry of Transport and Construction of the Soviet Union which was responsible for highways during the Soviet period. In more recent years, the SNIP were carefully modified to reflect the introduction of international standards for road design, especially the aspect of road safety, and also to address the challenges posed by the expansion of a market economy in the 12 CIS countries and Mongolia. However, as the various road standards of the SNIP retained strong influence of the old road standards, their negative impacts on road function and their conformity with the future image of road improvement, which must be given priority to maintain the viability of the standards for a changing local situation, could no longer be ignored.

Under these circumstances, new road design standards (a Russian version is available) for Tajikistan were formulated in 1998 with the assistance of the ADB. The new road design standards which depart from the conventional SNIP are characterised by emphasis on the establishment of category standards which take the expected functions and service standard of roads into consideration. The new road design standards permit the application of exceptional rules in the case of road rehabilitation projects as long as such application does not lower the functions of the existing road. For the Project, a technical note compiling the main specifications based on the new road design standards was submitted to the implementation organization in Tajikistan during the field survey for the basic design. This note was then discussed and agreed by both sides.

Geometric Structure and Design Speed

In consideration of the standards applied to the target road, the topography and continuity with the section rehabilitated with ADB assistance and also the section

being rehabilitated with Japanese grant aid, the design speed for the target road of the Project is set at 80 km/hr with one exception. The application of an 80 km/hr design speed to urban areas, such as Kurgan Tyube and Kolkhozabad, and also to major intersections would necessitate the relocation of houses or the introduction of a bypass as a major detour for the existing road which is beyond the scope of the planned rehabilitation under the Project. Accordingly, a design speed of 40 km/hr which allows tracing of the existing route is planned for urban areas and major intersections as an exception to the design speed of 80 km/hr.

Table 2-9 List of the Design Values Adopted for the Project

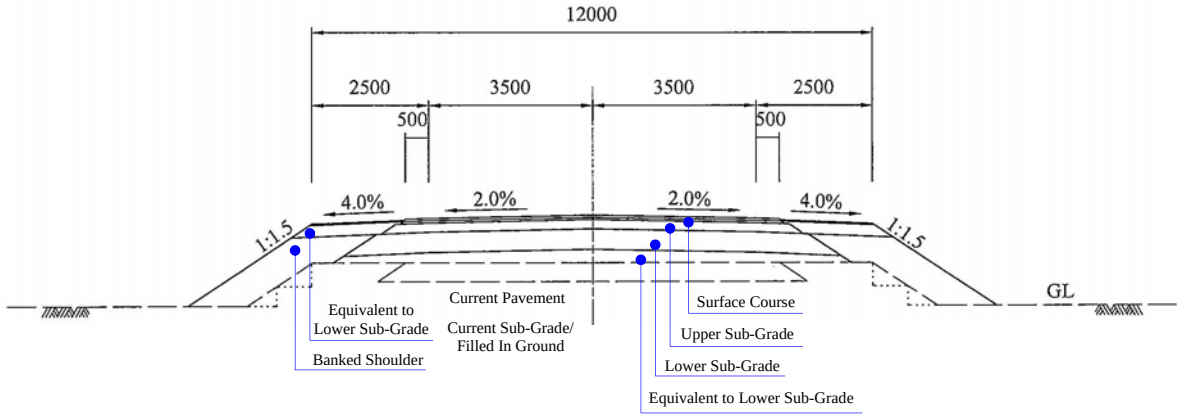
Item		Unit	Applicable Topography		
			Flat Land	Hill	Mountain
Road Category		-	III		
Design Speed		km/hr	100 (80)	80 (60)	50 (30)
No. of Carriageways		No.	2		
ROW Width *1		m	50		
Carriageway Width		m	7.0 (3.5 x 2)		
Shoulder Width		m	2.5 (including a paved shoulder width of 0.5 m)		
Road Surface Cross Slope		%	2.0		
Shoulder Cross Slope		%	4.0		
Minimum Curve Radius *2		m	380	230	125
Maximum Longitudinal Slope		%	3 (8)	5 (8)	8 (10)
One-Way Grade (Maximum Value)		%	6	6	6
Sight Distance		m	205 (157)	140 (113)	85 (74)
Banked Slope	Ordinary Soil	Grade	1: 1.5 – 2.0 (depending on the soil type)		
Cut Slope	Hard Rock	Grade	1: 0.5		
	Weathered Rock	Grade	1: 0.75		
	Other than Rock	Grade	1: 1.0 – 1.5 (depending on the soil type)		
Pavement Type		-	Carriageway = AC; shoulder = BST		

Notes : The figures in bracket are the threshold value; AC = asphalt concrete; BST = bituminous surface treatment
*1 A Presidential Decree in 2006 set the ROW at 50 m wide for urban areas and 100 m wide for other areas.
*2 The exceptional minimum radius for urban areas is 30 m.

③ Cross-Section of the Target Road

The cross-section of the road for the Project is shown below based on the application of the road design standards for a Category III road in Tajikistan.

Standard Cross-Section (General)



Standard Cross-Section (Urban Area)

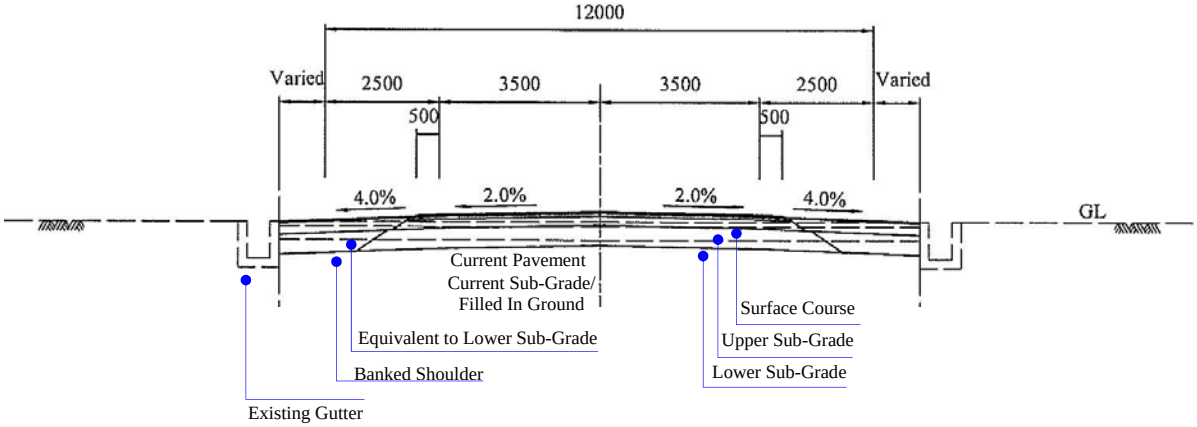


Fig. 2-3 Cross-Section of the Target Road

④ Pavement Design

The pavement design for the Project is based on the AASHTO Guide for Design of Pavement Structures (1993) of the US as in the case of the road section rehabilitated by the ADB and Dusti-Nizhniy Pyandzh Road of which the rehabilitation is currently in progress with Japanese grant aid.

a) Design Conditions

The design conditions used for the pavement design are listed below.

Design service period	:	10 years from 2009 to 2018
Traffic load	:	Number of 18 kip equivalent single axle loads over the design period

Reliability (R)	:	The probability of the traffic load and pavement strength being within the assumed ranges is estimated to be 95% in view of the status of the target road (standard deviation ZR = 1.645; standard deviation of load and pavement strength SO = 0.45).
Serviceability criteria	:	Initial serviceability index Po = 4.2 (AASHTO road test result) Terminal serviceability index Pt = 2.5 (standard AASHTO value for trunk roads)
Soil resilience modulus (MR)	:	To be calculated using the formula of MR = 1,500 x CBR based on the evaluated CBR value of the sub-grade
Structural layer coefficients	:	Asphalt-concrete surface course a = 0.44 Granular upper sub-grade (CBR = 80) a = 0.14 Granular lower sub-grade (CBR = 30) a = 0.13
Drainage coefficient	:	Granular upper sub-grade m = 1.0 Granular lower sub-grade m = 1.0

b) Road Sections Based on the State of the Existing Pavement and Traffic Load

The target road is divided into 10 sections as shown in Fig. 2-4 based on the bearing power of the foundations of the existing road and the thickness and condition of the existing pavement.

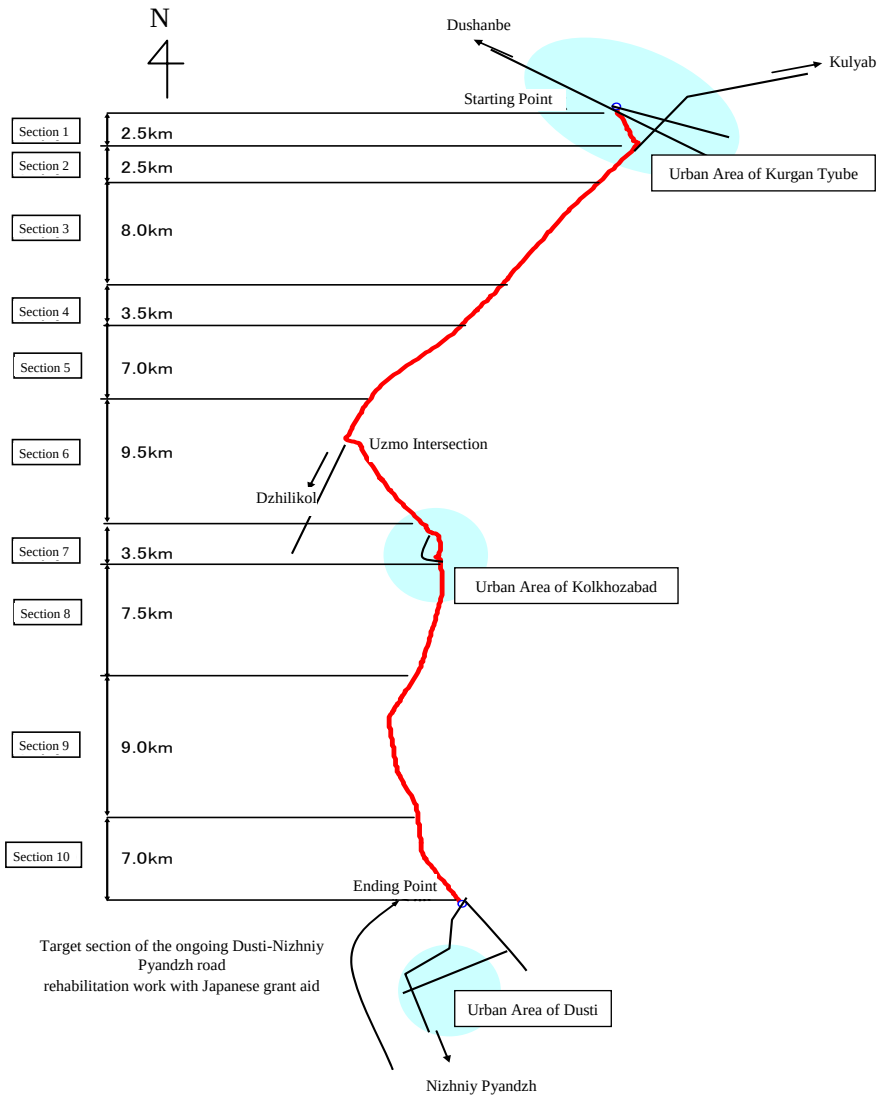


Fig. 2-4 Sectioning of the Target Road

The likely traffic load was estimated based on the results of the traffic volume survey conducted as part of the field survey while taking the annual trend of the assumed daily traffic volume of 1,000 vehicles at the Nizhniy Pyandzh Bridge which was opened on 26th August, 2007 into consideration. The estimated results of the total traffic volume in both directions for each section during the design service life is 9,671 vehicles per day for Section 1, 5,740 vehicles per day for Section 2 through Section 7 and 6,920 vehicles per day for Section 8 through Section 10. Conversion of the load of these traffic volumes on the road during the design service period, taking the mixed ratio of large vehicles in each section (approximately 7%) into consideration, to the standard axial load (18 kip (8.2 tons) ESAL) produces 20.3 million axles in Section 1, 16.5 million axles in Section 2 through Section 7 and 20.1 million axles in Section 8 through Section 10.

c) Pavement Structure Indices

For the pavement design for the Project, the pavement structural number (SN) required for the target road was estimated using the basic formula for flexible pavement (nomogram for the design of flexible pavement) in the AASHTO Guide. In addition, the design pavement structure index corresponding to the estimated traffic load was calculated for each section based on the bearing power of the foundations of the existing road and the thickness and condition of the existing pavement, etc. mentioned earlier. The pavement structure to satisfy these design values was then examined to formulate the pavement plan for the Project.

Table 2-10 Required Pavement Structure Index (SN)

Section *1	1	2	3	4	5	6	7	8	9	10
Cumulative 18 kip ESAL (W18) in million axles	20.4	16.5						20.1		
Standard Deviation (Zo)	-1.645									
Standard Error (So)	0.45									
Difference in Serviceability Index (Δ PSI = Po – Pt)	1.7									
Sub-Grade Resilience Modulus (Me)	10500	15000		13500		15000	10500			
CBR	7	10		9		10	7			
Required Pavement Structural Number (SN)	5.3	4.6		4.8		4.6	5.0	5.3		

* The target road is divided into the following 10 sections based on the bearing power of the foundations of the existing road and the thickness and condition of the existing pavement, etc.

Section 1: km 0+000 ~ 2+500 Section 2: km 2+500 ~ 5+000 Section 3: km 5+000 ~ 13+000
Section 4: km 13+000 ~ 16+000 Section 5: km 16+500 ~ 23+500 Section 6: km 23+500 ~ 33+000
Section 7: km 33+000 ~ 36+500 Section 8: km 36+500 ~ 44+000 Section 9: km 44+000 ~ 53+000
Section 10: km 53+000 ~ 60+000

Basic Formula of Nomogram

$$\log_{10} W_{18} = z_R * S_0 + 9.36 * \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 * \log_{10} M_R - 8.07$$

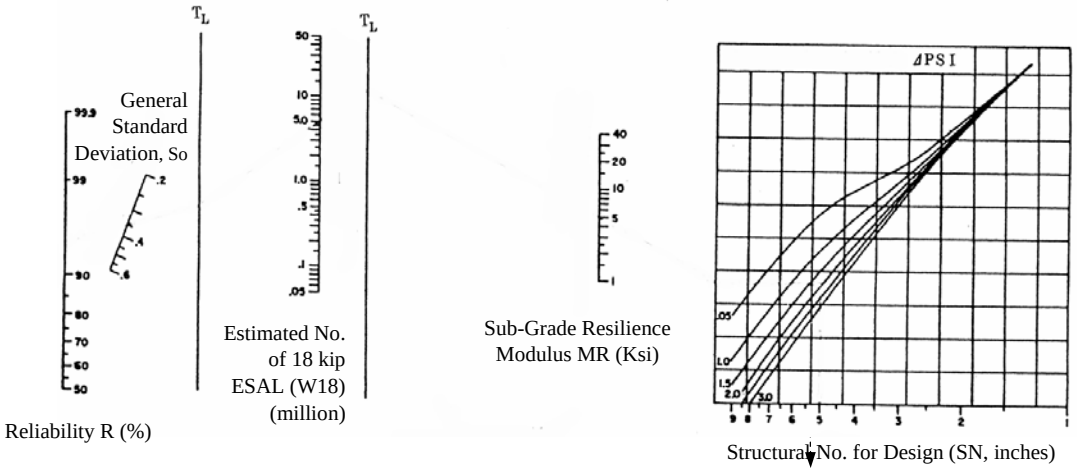


Fig. 2-5 Nomogram for Flexible Pavement Design

d) Pavement Structure

Based on the above analysis, the planned pavement structure for each section of the target road is shown in Table 2-11.

Table 2-11 Required Thickness of Each Course and Structural Index based on the Pavement Design for the Project

Section	Item	Surface Course AC	Base Course AC	Upper Sub-Grade	Lower Sub-Grade	Planned SN	Required SN	Judgement Result
	Layer Coefficient	0.44	0.44	0.14	0.13			
	Drainage Coefficient	-	-	1.0	1.0			
1, 8, 9, 10	Thickness (cm)	5.0	5.0	20.0	51.0	5.44	5.30	OK
	Thickness (inches)	2.0	2.0	7.9	20.1			
	SN	0.9	0.9	1.1	2.6			
2, 3, 6	Thickness (cm)	5.0	5.0	20.0	35.0	4.63	4.60	OK
	Thickness (inches)	2.0	2.0	7.9	13.8			
	SN	0.9	0.9	1.1	1.8			
4, 5	Thickness (cm)	5.0	5.0	20.0	39.0	4.83	4.80	OK
	Thickness (inches)	2.0	2.0	7.9	15.4			
	SN	0.9	0.9	1.1	2.0			
7	Thickness (cm)	5.0	5.0	20.0	44.0	5.09	5.00	OK
	Thickness (inches)	2.0	2.0	7.9	17.3			
	SN	0.9	0.9	1.1	2.3			

Note: AC = asphalt concrete; SN = structural number; refer to Table 2-10 for further details for each section; the construction thickness of the lower sub-grade is given after the thickness of the existing road is subtracted from the required thickness.

Based on the results of various surveys/tests (deflection test, material sampling and laboratory test and DCP test, etc.), the existing pavement was converted/evaluated as the thickness of the lower sub-grade and was added to the pavement plan for the Project, resulting in the planned construction of the various courses shown in Table 2-12.

Table 2-12 Construction Thickness of Each Course for the Target Road

Unit: cm

Section		1	2	3	4	5	6	7	8	9	10
Surface Course		10	10	10	10	10	10	10	10	10	10
Upper Sub-Grade		20	20	20	20	20	20	20	20	20	20
Sub-Grade	Construction Thickness	11	15	15	24	19	15	4	11	21	11
	Converted Thickness	40	20	20	15	20	20	40	40	30	40
	Total Thickness	51	35	35	39	39	35	44	51	51	51

Note: Construction thickness = construction thickness under the Project
Converted thickness = converted thickness of the existing pavement
Refer to Table 2-10 for further details of each section.

⑤ Earthwork Plan

The basic principles for the Project are the tracing of the existing road and the formulation of a plan for the maximum use of the existing road. For this reason, a shallow banking structure will be employed as this will allow the maximum use of the exiting filled ground and sub-grade. A special design height is adopted for those sites likely to be influenced by irrigation water, etc. The introduction of an earth gutter will be considered at those places where no drainage facility currently exists at the roadside. The standard slope gradient for banking is set at 1: 1.5 in view of the quality of the soil locally available.

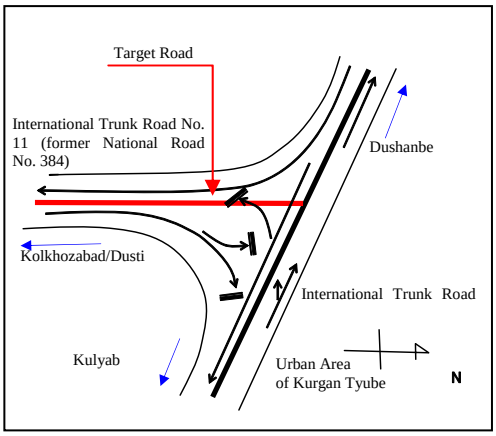
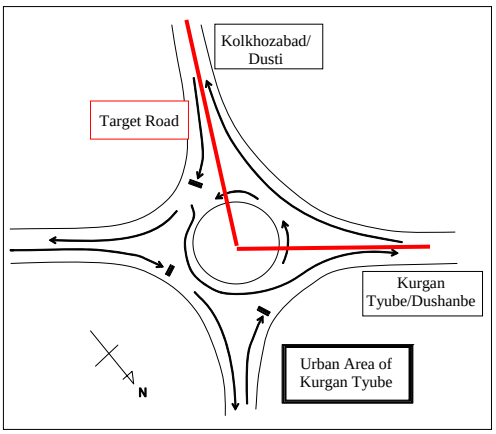
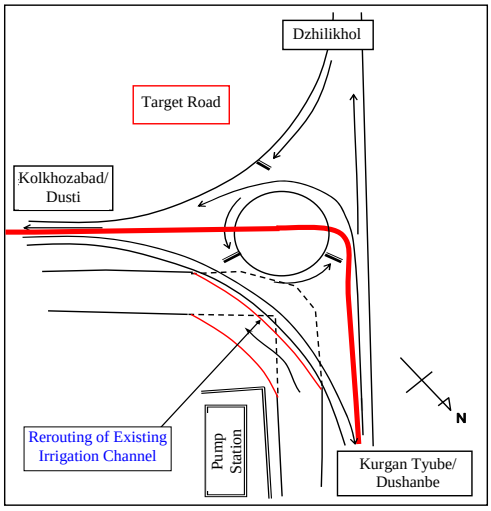
⑥ Intersection Plan

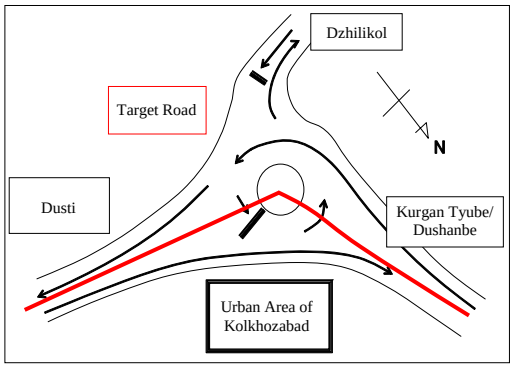
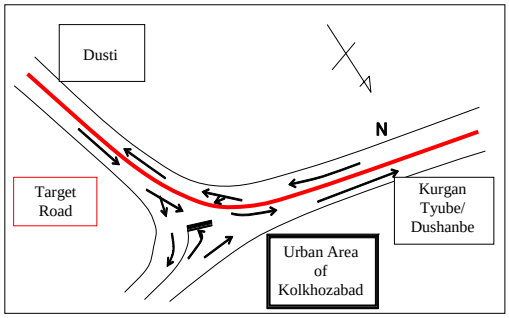
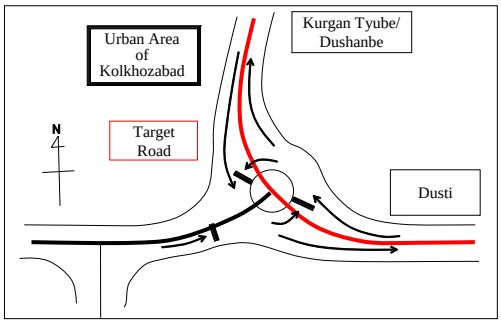
a) Major Intersections

The alignment for the intersections of the target road is planned based on a design speed of 4 km/hr.

The configuration of the existing intersection is basically inherited and the minimum radius at an intersection is set at 30 m to minimise the impacts on the surrounding area, such as the relocation of houses, as much as possible. Where necessary, a roundabout will be introduced. Moreover, the status of the principal road and subordinate roads is clearly established to ensure that each road can smoothly perform its functions under a level intersection design. As advance review of the intersection plan by the Transport Police is necessary as part of the design review, including the review for environmental permission, approximately two months is required to complete the review procedure. The main intersections of the target road are outlined in Table 2-13.

Table 2-13 Outline of the Intersection Plan

No.	Distance from Starting Point	Configuration of Intersection	Remarks
1	0.00 km	Kurgan Tyube Intersection 	The configuration of the existing intersection between Dushanbe-Kurgan Tyube-Kulyab Road and the target road of the Project is inherited. The former is considered to be the principal road and the latter is considered to be a subordinate road for planning of the traffic flow at this intersection. The area relating to the ADB project is excluded from the target area to avoid any duplication of the target rehabilitation area.
2	2.63 km	Kurgan Tyube Intersection 	The existing roundabout-type intersection is inherited. The distinction between the principal road and subordinate road is based on the actual traffic flow at the existing roundabout.
3	26.48 km	Uzmo Intersection 	The Uzmo interchange is located nearly halfway along the target road, forming a T junction where the road from Kurgan Tyube to Dzhilikol meets the road from Kolkhozabad. The latter is considered to be the principal road because of its status. A roundabout is planned here to meet the restrictive conditions at the site after their confirmation with the MOTC. There is an irrigation pump station nearby and an earth ditch with a depth of some 5 m and a width of 15 m runs between the station and the existing road. For improvement of this intersection, the re-routing of part of this ditch is necessary.

No.	Distance from Starting Point	Configuration of Intersection	Remarks
4	33.43 km	Kolkhozabad Intersection 1  	This roundabout-type intersection is located near the market at the heart of the urban area of Kolkhozabad. The existing configuration is inherited for the Project and due consideration is given to ensuring smooth traffic flow, including that of large vehicles. The target road is considered to be the principal road for planning purposes.
5	34.35 km	Kolkhozabad Intersection 2  	This is a Y-shaped intersection located some 300 m after branching out from the main route in the urban area of Kolkhozabad. The existing configuration is inherited for the Project and due consideration is given to smooth traffic flow, including that of large vehicles. The target road is considered to be the principal road for planning purposes.
6	35.88 km	Kolkhozabad Intersection 3  	This intersection is located at the southern end of the urban area of Kolkhozabad, forming a T junction between the road heading towards central Kolkhozabad from Dusti and the road turning right. Large vehicles are prohibited from travelling towards the city centre. While the existing configuration is inherited for the Project, a roundabout which does not affect nearby houses, etc. will be introduced. The target road is considered to be the principal road for planning purposes.

b) Other Intersections

Intersection with Dusti-Nizhniy Pyandzh Road under rehabilitation at the ending point of the target road: The target road is linked to the end section of Dusti-Nizhniy Pyandzh Road under rehabilitation. As the end section in question has no other roads with which it connects other than the target road of the Project, direct connection is planned based on the standard road width.

Railway crossings: Based on the confirmed state of current railway operation, the same road alignment as that of the existing level crossings is adopted.

⑦ Bridge Replacement Plan

a) Existing Channels at Bridge Sections

All of the existing bridges to be rehabilitated under the Project cross an irrigation channel of which the following details have been confirmed.

- All of them are man-made irrigation channels and the discharge and water level are controlled by a water gate or other situated upstream.
- According to the results of interviews with local residents and others, there is no information indicating that the water level of any irrigation channel has reached a dangerous level in the period of some 50 years since the 1960's when the main bridges were built to the present day. (Therefore, use of the existing clearance under the girders of the existing bridges as the reference clearance for the new structures will enable the new structures to deal with floods with a return period of some 50 years.)
- The water level of the irrigation channels is controlled at approximately 0.0 m – 0.5 m in the four month period from December to early April.
- The existing maximum design discharge can be dealt with by a series of three box culverts.
- As the irrigation channels run through well-tended cultivation areas, there are no floating objects, such as driftwood, which could block the channels.

Water flow situation at Irrigation Channel No. 1 (July, 2007)

Water flow situation at Irrigation Channel No. 1 (November, 2006)

Water flow situation at Irrigation Channel No. 11 (July, 2007)

Water flow situation at Irrigation Channel No. 11 (November, 2006)

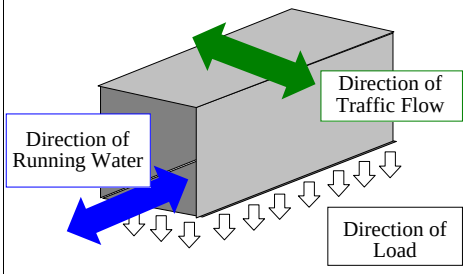
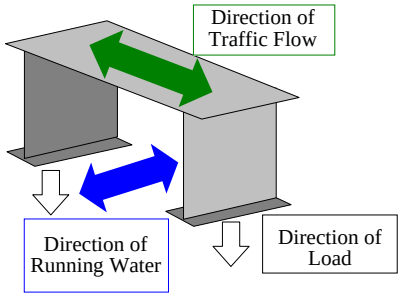
Fig. 2-6 Seasonal Changes of the Water Level of Irrigation Channels

b) Examination of the Structure to Replace the Existing Bridges

In consideration of the situation of the existing irrigation channels described above, several types of structures to replace the existing bridges were examined and a box culvert structure was selected because of the following reasons.

- It is economical in terms of the main work and temporary work.
- The construction work will simply consist of common temporary work for concrete placing.
- Given the water level of 0.0 – 0.5 m of the irrigation channels, the entire work can be completed in a single dry season, offering an attractive prospect in terms of the work scheduling.
- As the ratio of manual work is high, the inexpensive local workforce can be effectively used.
- Compared to other bridge structures, neither joints nor bearings are required and, therefore, the maintenance cost is low.
- If a bridge structure is selected, the piles of the existing bridges will become obstructions, making the span of the new bridges unnecessarily long. In the case of a box culvert, as spread foundations are used, its introduction can be planned by simply considering the appropriate cross-sectional area of flow.

Table 2-14 Examination of Structures to Replace Existing Bridges

Item			Box Culvert-Type	Bridge-Type
Conceptual Drawing of the Type				
Characteristics			• The integral structure means that bearings are unnecessary. • By introducing earth cover above the culvert surface, the pavement structure of the road can be made continually smooth without expansion joints.	• There are three structural components, i.e. super-structure, sub-structure and foundations. • Bearings are required between the super-structure and sub-structure and expansion joints are required to ensure continual joining with the road surface.
Suitability for the Planned Site			Both the discharge and water level can be planned based on the maximum water level with a return period of 50 years.	Both the discharge and water level can be planned based on the maximum water level with a return period of 50 years.
Past Use in Tajikistan			The triple box culvert system is used for the neighbouring Dusti-Nizhniy Pyandzh section and can also be applied for the Project as up to three box culverts are required at each bridge site.	While many bridges have been constructed with PC floor board, RCT girders and steel girders, not many PC girder bridges with the planned span under the Project have been constructed.
Compatibility with the Geology at the Planned Site			As the required modulus of the sub-grade reaction is less than 10 tf/m^2, spread foundations can be employed using the gravely sandy sand at the construction sites as the supporting layer.	Pile foundations are judged to be the suitable type of foundations as in the case of the existing bridges.
Item		Unit	(Triple culvert with a height of 6 m and a total span of some 17 m)	(PC girder bridge with a height of 5 m and a total span of some 17 m)
Main Qty.	RC	m^3	approx. 700	approx. 500
	Foundation Piles	Yes/ No	Not required	approx. 6 piles (∅ 1,000 mm) cast-in-place per abutment
Ratio of Estimated Cost (per Site)			1.0	3.0 ~ 5.0
Ratio of the Maintenance Cost (20 years)			1.0	10 or more
Estimated Work Duration (months/site)			maximum: 4.0	6.0 or more
Evaluation Result			O (superior economy and workability)	Δ (inferior economy and workability)

⑧ Box Culverts

a) Design Dimension of Box Culverts and Installation Method

For the replacement of the existing bridges, it has been decided to use up to three box culverts based on the examination result of the dimensions of the existing bridges and the design discharge and water level of the irrigation channels concerned. The principal members of these culverts are reinforcing bars (D10 –

D32) which can be locally procured. Table 2-15 shows the details of the box culvert(s) at each planned work site.

Table 2-15 Box Culvert(s) for Replacement of Existing Bridges

No.	Km	Planned Work	Total Culvert Length (m)	No. of Cells	Internal Void Width B (m)	Internal Void Height H (m)	Internal Void Width of Extra Span Bs (m)	Internal Void Height of Extra Span Hs (m)
1	1 + 000	Single Box Culvert	18.0	1	5.00	2.40		
2	2 + 250	Triple Box Culvert	18.0	3	7.00	6.30	5.00	6.30
3	11 + 400	Double Box Culvert	13.0	2	4.50	3.50	4.50	3.50
4	13 + 600	Single Box Culvert	13.0	1	6.00	5.20		
5	14 + 800	Double Box Culvert	13.0	2	4.50	2.20	4.50	2.20
6	27 + 400	Single Box Culvert	15.0	1	3.00	4.50		
7	28 + 050	Repair of Expansion Joints and Repaving						
8	30 + 100	Single Box Culvert	17.5	1	7.00	4.30		
9	30 + 700	Single Box Culvert	13.0	1	8.00	5.70		
10	30 + 900	Triple Box Culvert	15.0	3	8.00	5.70	8.00	5.70
11	36 + 200	Triple Box Culvert	14.0	3	7.50	4.70	7.50	4.70
12	46 + 800	Single Box Culvert	13.5	1	7.00	2.70		
13	46 + 830	Removal and Banking						
14	52 + 200	Double Box Culvert	13.0	2	5.00	3.00	5.00	3.00

All of the box culverts listed above can be constructed using common form and supports. Even the largest triple box culvert (No. 2) can be constructed within a period of approximately four months from December to April which is the dry season in Tajikistan.

b) Water Level at Time of Construction Work and Traffic Detour Using the Existing Road

In view of the fact that the water level of the irrigation channels of 0.0 – 0.5 m is very low in the four month period from December to early April every year, the use of a submerged pump is planned for the temporary dewatering work. A detour to divert the traffic flow on the current road during the construction period can be set up in the form of a banked route as the water level is low.

c) Geology of the Box Culvert Construction Sites

The soil in the project area mainly consists of sandy soil and silt. The converted N value based on the dynamic penetration test is around 10 – 20 up to a depth of some 5 m from the ground surface. Below this lies relatively compacted sandy

soil with the partial distribution of a gravel layer. The geological survey results confirm that spread foundations can be used to support the box culverts to replace the existing bridges as the bearing power of the ground is strong enough except at the sites of the No. 11 and No. 12 bridges. The bearing power at the sites of the No. 11 and No. 12 bridges can be improved for the use of spread foundations by replacing the existing soil for a depth of 2 m from the planned bottom position of the box culvert with good soil.

d) Partial Repair of Existing Bridge No. 7

Among the existing bridges targeted for rehabilitation, the steel girder bridge No. 7 crosses the Obishule Irrigation Channel which was constructed in the period from 1993 to 1994. Only this bridge among the 14 target bridges corresponds to the design load of HK-80 (similar to TL-25 in Japan) applied to Category III roads. The external appearance of such main structural components as the main girders, floor slabs and abutments is generally good without any serious damage. Because of this, it has been decided that only repair work at the necessary places will be conducted for this bridge.

e) Repair of the Expansion Joints

The existing expansion joints on both sides of the bridges are damaged. If such damage is not addressed, it will extend due to the live load of vehicles, ultimately resulting in the decline of the durability of the bridge proper. Therefore, the repair of these expansion joints is included in the Project. The type of expansion joints planned is the use of load support-type ready-made joints due to the ease of their procurement from a third country and their compatibility with the design future traffic volume.

Fig. 2-7 State of Expansion Joints at Existing Bridge No. 7

f) Repair of the Bridge Deck Pavement

The existing bridge deck pavement has become uneven, disrupting the smooth travelling of vehicles. This undulating surface prompts handling mistakes by drivers and poses a risk of causing serious traffic accidents at the bridge. To

rectify the situation, repair of the bridge deck pavement is planned under the Project. Given the fact that the existing bridge deck pavement has already been overlaid, removal of the existing pavement prior to applying a new pavement is planned.

g) Repainting of the Abutments of the Old Bridge

Due to the following reasons, it has been decided that the scope of the Project will not include repainting of the steel of the super-structure, such as the main girders, or removal of the left-over abutments of the old bridge.

i. Repainting

Fig. 2-8 State of Painting of the Super -Structure of Existing Bridge No. 7

Although existing Bridge No. 7 is more than 10 years old, no rusting of the steel of the super-structure, such as the main girders, is observed because of the anti-rusting coating applied at the time of construction. As the flange ends of the main girder and other places susceptible to rusting due to the likelihood of a thinner coating appear to be fine, it appears that the super-structure does not have any problem areas requiring repainting. Given the fact that the project area is generally dry, it is unlikely that rust will suddenly appear in the coming years. For this reason, the repainting of this bridge is judged not to be an urgent requirement and is not included in the scope of the Project.

ii. Removal of Old Abutments

There are left-over abutments of the old bridge near the abutments of Bridge No. 7. These old abutments are pile bent abutments using steel piles and are not causing any blockage of the irrigation channel. According to the agreement signed in 1994 for the construction of the present bridge, the removal of the old abutments was the responsibility of the contractor. This discovery by the joint survey with the engineer entrusted by the MOTC means that the contractor for the old bridge has failed to fulfil its responsibility. Given this situation, it has been decided that the removal of the old abutments is not included in the scope of the Project.

Fig. 2-9 State of the Abutments of Existing Bridge No. 7

Fig. 2-10 State of the Abutments of Existing Bridge No. 7

h) Planned Removal of Existing Bridge No. 13

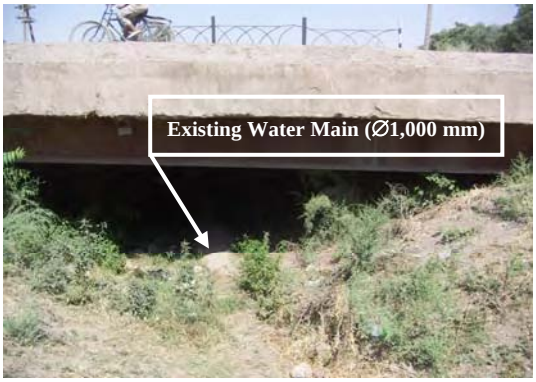


Fig. 2-11 Existing Water Main (∅1,000 mm) under Existing Bridge No. 13

Existing Bridge No. 13 is a triple span continuous steel girder bridge constructed in the 1960's. The reference materials for the design discharge of the irrigation channel over which this bridge is situated confirm that the channel is no longer functioning. A field survey of the area found that houses are built in the upstream area where the channel has been filled in, indicating the complete discontinuation of this channel. For this reason, replacement of the existing bridge to maintain the channel function is judged to be unnecessary and the removal of the bridge and filling in of the channel to the design road level is planned under the Project. The 1.0 m diameter water main laid immediately below the existing bridge and across the road will be relocated at the expense of the Tajikistan side.

⑨ Design of Box Culverts

a) Design Width of Box Culverts

The design width of a box culvert is based on the standard width of the road.

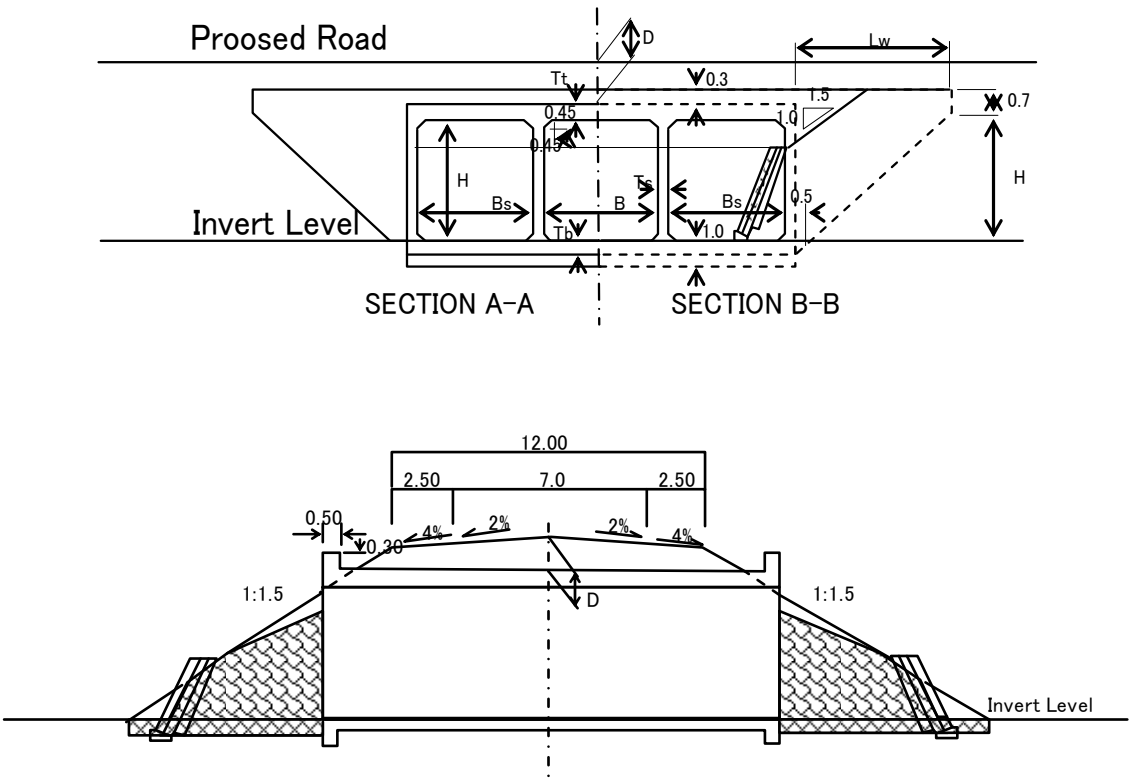


Fig. 2-12 Cross-Section of Main Structure (Box Culvert)

b) Design Conditions

Applicable Standards

The design of a box culvert complies with the Japanese Specifications for Highway Bridges.

Design Load

i. Live Load

The design live load to be used is the design load TL25 of Japan. When expressed in terms of a concrete vehicle, this live load allows the travelling of a dump truck with a total weight of 25 tons, a maximum axle load of 20 tons and a wheel load of 10 tons. The standard strength used for the design of the reinforcing bars and concrete based on such a live load is given below.

Reinforcing bar : SD295 (yield point: 295 N/mm^2)
Concrete : σck = 24 N/mm^2

ii. Seismic Load

The earthquakes observed in the area along the target road are relatively small and the Construction Standards for Earthquake Zones (1982 Edition) of the former Soviet period classify the project area as being in the zone requiring the least consideration of earthquakes among three earthquake zones. Accordingly, the horizontal seismic coefficient is usually considered for the design of the sub-structure and foundations of a bridge even in a zone where the least consideration of earthquakes is required. In the case of a box culvert, however, as there is no distinction between the super-structure and the sub-structure because of its integral structure, no special consideration is given to earthquakes following the general design procedure.

⑩ Auxiliary Road Facilities

a) Gabions

The employment of gabions in suitable places is planned to prevent scouring of the box culvert and of the inlet and outlet of the cross-drainage structures.

b) Cross-Drainage Structures

In regard to the rehabilitation of the cross-drainage structures, it is planned to re-use the existing structures. Cross-drainage structures have been found at 77 sites along the target road for the purpose of irrigation water or water drainage from the road surface. Even though no serious damage, such as the collapse of a structure, has been observed, many of these structures are not properly functioning because of deposited mud and/or the propagation of plants. As a result, standing water occurs near the drainage culvert, weakening the filled up ground and sub-grade of the road. The target road has roadside gutters to drain water from the road surface and/or to act as an irrigation channel along some 67% of the entire route. Many of these dug gutters are failing to perform a good drainage function due to deposited mud and/or the propagation of plants. The long-lasting standing water in these gutters is believed to be one cause of the weakening of the filled up ground and sub-grade of the road. As the maintenance, including cleaning, of the existing cross-drainage structures is very important, it is recommended that maintenance be conducted at the expense of the Tajikistan side. Examination of the alignment of these structures has found an insufficient installation length in some places and it has been decided to extend the existing structure at such places. As part of the intended extension work, suitable inlet and outlet locations and structures for the extended part have been examined and designed accordingly.

Inlet of a cross-drainage pipe flooded with drained irrigation water near the distance mark of 31 + 000 km

Inlet of a cross-drainage pipe filled with sediment near the distance mark of 30 + 000 km

Fig. 2-13 Situation of Cross-Drainage Structures

c) Guard Posts

The introduction of guard posts is planned at curved road sections and near major structures where found to be necessary to urge drivers to maintain safe and smooth driving.

d) Maintenance Posts for Cross-Drainage Structures

As the proper management of water drainage at the roadsides is closely linked to the long serviceability of the target road, it has been decided to introduce one concrete post each (the structure of which is the same as that of a guard post) for the smooth maintenance of the cross-drainage structures on both sides of a cross-drainage structure.

e) Distance (km) Posts

Distance (km) posts will have a structure whereby the distance from the starting and ending points can be independently indicated so that such distance can be checked from either direction of the traffic flow. These posts will be installed every 1 km.

f) Retaining Walls

A masonry retaining wall is planned where judged to be necessary for the purpose of securing the banked soil at the side of a culvert and at the inlet and outlet sections of cross-drainage structures.

b) Road Markings

The centre line as well as edge lines of the road are planned in accordance with the standard specifications in Tajikistan as in the case of Dusti-Nizhniy Pyandzh Road. At each of the planned intersection sites, zebra crossing road markings are planned to indicate pedestrian crossings.

⑪ Branch Roads and Others

Minor roads linked to the target road can be classified into those with an AC pavement and others (road with a simple pavement or earth road). It is planned to apply an AC pavement to the necessary sections of the roads which currently have an AC pavement and a simple pavement (DBST) to other roads. As the entrances to petrol stations along the route will be subject to a heavy load by large vehicles, the introduction of an upper sub-grade and AC pavement is planned for the necessary areas. The access roads to roadside houses along the route will be sloping and will have a simple pavement (DBST) as in the case of the planned shoulders for the target road.

2.2.3 Basic Design Drawings

The principal basic design drawings based on the basic concept of the Project described above are listed in Table 2-16. All of the related drawings are attached in the Appendix. The drawings for the Project use Dusti as the starting point.

Table 2-16 List of the Principal Basic Design Drawings

Drawing No.	Contents	No. of Drawings
BD 1-12	Plan, Vertical Section and Standard Cross-Section of the Road	12
BD 13 – 20	Structural Drawings	8
BD 21 – 23	General Drawings of Box Culverts	3