



NATIONAL DISASTER MANAGEMENT AUTHORITY

SAFER PAKISTAN | RESILIENT PAKISTAN



POST-MONSOON 2026

ASSESSMENT OF INFRASTRUCTURE DAMAGES & RESILIENCE NEEDS REPORT



HOUSES



ROADS



BRIDGES

PREPARED BY:

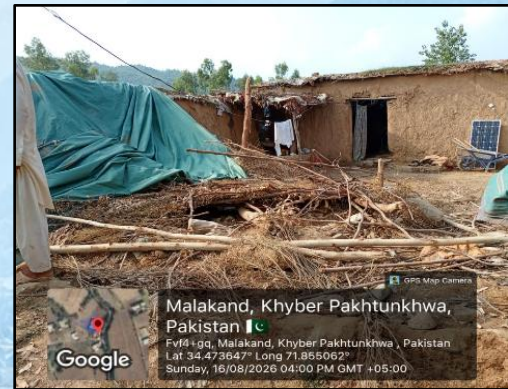
**INFRASTRUCTURE ADVISORY
& PROJECT DEVELOPMENT (IA&PD) WING**

**BUILDING RESILIENCE FOR
A SAFER TOMORROW**

MONSOON 2026 DAMAGES AT A GLANCE

1,839 HOUSES DAMAGED	623 FULLY DAMAGED	34.92km ROADS DAMAGED	41 BRIDGES DAMAGED
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- Monsoon 2026 concentrated largely in the Northern Pakistan.
- Gilgit-Baltistan accounted for 85% of all bridge losses (35 of 41) and 71% of total road damage (24.61 of 34.92 km).
- 1,839 houses were damaged nationwide — nearly one in three (623) were completely damaged.
- Adobe, mud-mortar and unreinforced masonry dominate the housing failure record.
- Most transport failures were hydraulic: scour, debris-choked crossings, and undersized drainage.
- Reconstruction that repeats pre-monsoon site selection, materials and drainage will fail again.



Acknowledgement

The Infrastructure Advisory and Project Development (IA&PD) Wing of the NDMA is pleased to present the post-monsoon 2026 Infrastructure Damage Report. This report documents the extent of infrastructure damages, analyzes the underlying causes of failure, and provides recommendations to help mitigate such impacts during future monsoon seasons. We gratefully acknowledge the efforts of PDMAs, GBDMA, SDMA and provincial line departments for their timely provision of infrastructure damage data, which formed the foundation of this report. The IA&PD Wing also extends its appreciation to the NDMA Operations Wing and Provincial Coordination Cell for their valuable support and for supplying essential information required for the report's preparation.

Preface

The 2026 monsoon season caused infrastructure damage across Pakistan, particularly in the northern regions due to intense rainfall, flash floods, urban flooding, landslides, and erosion. In response, the National Disaster Management Authority (NDMA), through its Infrastructure Advisory & Project Development (IA&PD) Wing, has undertaken a post-monsoon assessment of reported damages to houses, roads, and bridges, covering the national, provincial, and district levels. This report presents a consolidated analysis of damages, underlying causes of infrastructure failures, and key recommendations for building resilience in future reconstruction and planning efforts. NDMA remains committed to fostering resilience through evidence-based planning and climate-adaptive infrastructure development. It is hoped that this report will contribute meaningfully to informed decision-making and to strengthening Pakistan's preparedness and response to future monsoon events.

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Table of Content

1. Introduction.....	12
2. Summary of Infrastructure Damages	13
3. District-Level Provincial Infrastructure Damage.....	14
3.1 Khyber Pakhtunkhwa	14
3.1.1 Summary of Damages	14
3.1.2 Spatial Overview of Damages	15
3.1.3 Incident Details	16
3.2 Punjab.....	18
3.2.1 Summary of Damages	18
3.2.2 Spatial Overview of Damages	19
3.2.3 Incident Details	20
3.3. Balochistan	23
3.3.1. Summary of Damages	23
3.3.2. Spatial Overview of Damages	23
3.3.3. Incident Details	24
3.4. Sindh.....	26
3.4.1. Summary of Damages	26
3.4.2. Spatial Overview of Damages and Incident Details	26
3.5. Gilgit Baltistan	27
3.5.1. Summary of Damages	27
3.5.2. Spatial Overview of Damages	28
3.5.3. Incident Details	29
3.6. Azad Jammu and Kashmir	33
3.6.1. Summary of Damages	33
3.6.2. Spatial Overview of Damages	33
3.6.3. Incident Details	34
4. Major Causes of Infrastructural Failures.....	35
4.1 Residential Infrastructure.....	36
4.1.1 Poor Site Selection	36
4.1.2 Inadequate Foundation Design.....	36
4.1.3 Foundation Soil Erosion.....	37
4.1.4 Blocked Drainage Systems	37
4.1.5 Ground Movement and Differential Settlement.....	37
4.1.6 Substandard Construction Materials.....	38
4.1.7 Lack of Proper Drainage.....	38
4.1.8 Soil Settlement.....	38

4.1.9	Encroachments on Natural Waterways	39
4.1.10	Inadequate Drainage Planning	39
4.1.11	Foundation Failure and Structural Cracking.....	39
4.2	Communication Infrastructure.....	39
4.2.1	Design and Structural Deficiencies	40
4.2.2	Poor Drainage and Undersized Structures	40
4.2.3	Slope Instability and Poor Site Conditions	40
4.2.4	Sedimentation and Debris Load	41
4.2.5	Soil Erosion and Landslide Impacts.....	41
4.2.6	Aging Infrastructure and Design Deficiencies	41
4.2.7	Unregulated Sand and Gravel Mining.....	42
5.	Key Recommendations for Resilient Infrastructure	42
5.1	Punjab.....	42
5.1.1	Communication Infrastructure.....	42
5.1.2	Residential Infrastructure.....	43
5.2	Khyber Pakhtunkhwa (KPK).....	44
5.2.1	Communication Infrastructure.....	44
5.2.2	Residential Infrastructure.....	45
5.3	Azad Jammu & Kashmir / Gilgit-Baltistan (AJ&K/GB).....	46
5.3.1	Communication Infrastructure.....	46
5.3.2	Residential Infrastructure.....	47
5.4	Sindh.....	48
5.4.1	Communication Infrastructure.....	48
5.4.2	Residential Infrastructure.....	49
5.5	Balochistan	50
5.5.1	Communication Infrastructure.....	50
5.5.2	Residential Infrastructure.....	51
6.	Conclusion	52

List of Tables

Table 1: Summary of Infrastructure Damages across Pakistan during Monsoon 2026	13
Table 2: District-Wise Summary of House Damages in Khyber Pakhtunkhwa (Monsoon 2026)	14
Table 3: District-Wise Summary of Road Damages in Khyber Pakhtunkhwa (Monsoon 2026)	14
Table 4: District-Wise Summary of Bridge Damages in Khyber Pakhtunkhwa (Monsoon 2026)	14
Table 5: District-Wise Summary of House Damages in Punjab (Monsoon 2026)	19
Table 6: District-Wise Summary of Road Damages in Punjab (Monsoon 2026)	19
Table 7: District-Wise Summary of Bridge Damages in Punjab (Monsoon 2026)	19
Table 8: District-Wise Summary of House Damages in Balochistan (Monsoon 2026)	23
Table 9: District-Wise Summary of House and Roads Damages in Sindh (Monsoon 2026)	26
Table 10: District-Wise Summary of House Damages in Gilgit Baltistan (Monsoon 2026)	28
Table 11: District-Wise Summary of Road Damages in Gilgit Baltistan (Monsoon 2026)	28
Table 12: District-Wise Summary of Bridge Damages in Gilgit Baltistan (Monsoon 2026)	28
Table 13: District-Wise Summary of House Damages in AJ&K (Monsoon 2026)	33

List of Figures

Figure 1: Spatial Distribution of Infrastructural Damages across Districts of Pakistan	13
Figure 2: Spatial Distribution of Infrastructural Damages across Districts of Khyber Pakhtunkhwa..	15
Figure 3: Spatial Distribution of Infrastructural Damages across Districts of Punjab	20
Figure 4: Spatial Distribution of Infrastructural Damages across Districts of Balochistan.....	24
Figure 5: Location: Tharparkar, Event: Rainfall / Lightening	27
Figure 6: Spatial Distribution of Infrastructural Damages across Districts of Sindh	27
Figure 7: Spatial Distribution of Infrastructural Damages across Districts of Gilgit-Baltistan	29
Figure 8: Spatial Distribution of Infrastructural Damages across Districts of Azad Jammu & Kashmir	33
Figure 9: Residential Settlements Located in	36
Figure 10: Flood Affecting Residential Structures (Inadequate Foundation Design)	36
Figure 11: Foundation soil erosion and scouring causing	37
Figure 12: Blocked drainage causing severe.....	37
Figure 13: Ground movement and differential settlement causing severe cracking, tilting, and partial collapse of a hillside residential structure.	37
Figure 14: Flood-damaged house constructed with substandard masonry materials,.....	38
Figure 15: Prolonged waterlogging around structures due to	38
Figure 16: Soil settlement causing foundation displacement, severe wall cracking,	38
Figure 17: Residential damage intensified by encroachment on natural waterways	39
Figure 18: Inadequate drainage planning causing prolonged waterlogging	39
Figure 19: Foundation failure and severe structural cracking caused by prolonged waterlogging and soil instability.....	39
Figure 20: Bridge failure and structural	40
Figure 21: Undersized and debris-choked culvert causing overtopping, road inundation, and embankment erosion.....	40
Figure 22: Slope instability causing road embankment failure	40
Figure 23: Sediment and debris accumulation clogging culvert	41
Figure 24: Soil erosion and landslide debris causing road embankment	41
Figure 25: Aging bridge infrastructure showing severe deterioration and	41
Figure 26: Bridge foundation Vulnerability due to unregulated sand & gravel mining	42
Figure 27: Ground anchor wall installation providing lateral slope stabilization.....	43
Figure 28: Retaining wall construction protecting an embankment or road edge from erosion.	43
Figure 29: Soil nailing application for in-situ slope reinforcement.	43
Figure 30: Stormwater drainage infrastructure designed to convey concentrated monsoon runoff. .	43
Figure 31: Cementitious waterproofing application to a foundation or below-grade masonry surface.	44

Figure 32: Bituminous coating application providing a waterproof membrane on exposed surfaces.	44
Figure 33: Pre-cast structural component used to improve construction quality and settlement resistance.	44
Figure 34: Pre-fabricated structural system enabling standardized, rapid residential reconstruction.	44
Figure 35: Ground anchoring system used to stabilize an unstable slope or structural element	45
Figure 36: Riprap protection installed to resist erosion at an embankment or channel bank.	45
Figure 37: Structural bracing providing lateral stability to a vulnerable element.	45
Figure 38: Shotcreting application stabilizing an exposed slope or structural surface.	45
Figure 39: Band beam and column reinforcement integrated into residential masonry construction.	46
Figure 40: Maintenance of a local surface drain to prevent water accumulation near structures.	46
Figure 41: Sloped/pitched roofing designed to shed monsoon rainfall efficiently.	46
Figure 42: Epoxy injection repair of a structural crack in masonry.	46
Figure 43: Shotcreting application on an exposed slope or structural surface for erosion protection.	47
Figure 44: Riprap protection at a vulnerable embankment or channel bank.	47
Figure 45: Structural bracing applied to a vulnerable communication infrastructure element.	47
Figure 46: Slope vegetation used to stabilize exposed terrain and reduce surface erosion.	47
Figure 47: Timber-reinforced house construction providing a lightweight, resilient structural system.	48
Figure 48: Pre-fabricated house system enabling rapid, standardized residential reconstruction.	48
Figure 49: Sloped roof construction designed for efficient rainwater and snow shedding.	48
Figure 50: Pitched roof profile minimizing water retention at the roof level.	48
Figure 51: Riprap protection installed at a bank or structure foundation exposed to sustained flood flow.	49
Figure 52: Culvert structure providing cross-drainage conveyance beneath a transport corridor.	49
Figure 53: Aqueduct structure maintaining hydraulic conveyance across an intersecting alignment.	49
Figure 54: Aqueduct structure illustrating conveyance design across a flow path.	49
Figure 55: Site grading and drainage provision directing runoff away from a residential structure.	50
Figure 56: Reinforcement measures applied to improve residential structural resilience.	50
Figure 57: Reinforcement of a housing structure to improve load-carrying capacity.	50
Figure 58: Improved adobe construction incorporating enhanced moisture protection	50
Figure 59: Concrete block protection installed around a bridge pier foundation.	51
Figure 60: Aqueduct structure maintaining conveyance across an intersecting flow path.	51
Figure 61: Hydraulic conveyance structure designed for flash-flood discharge conditions.	51
Figure 62: Trapezoidal drain channel providing efficient conveyance of concentrated runoff.	51
Figure 63: Elevated housing construction reducing exposure to flash-flood inundation.	52

Figure 64: CGI sheet roofing providing rapid rainwater shedding.	52
Figure 65: Cement-based waterproofing application on a residential structure.....	52
Figure 66: Durable surface coating applied for weathering resistance.....	52



1. Introduction

The Monsoon 2026 posed significant hydro-meteorological challenges specifically across Northern Pakistan, resulting in widespread infrastructure damage, disruption of essential connectivity, and impacts on communities across the country. Intense rainfall, flash floods, urban flooding, landslides, and associated erosion caused damage to residential structures, roads, and bridges across provinces and administrative regions.

The impacts were particularly pronounced in vulnerable areas where topography, exposure to flood hazards, inadequate drainage systems, structural vulnerabilities, and erosion increased the susceptibility of infrastructure to damage. In several locations, recurring flooding and weak infrastructure conditions further aggravated the impacts, highlighting Pakistan's continued vulnerability to monsoon-related hazards and the need for improved resilience in infrastructure planning and development.

The Infrastructure Advisory & Project Development (IA&PD) Wing of NDMA, compiled this report on post-Monsoon 2026 Infrastructure Damage Failure and Resilience Needs to evaluate the extent of reported damages across all provinces and administrative regions.

The purpose of this report is to provide a consolidated and analytical overview of infrastructure damages of Monsoon 2026, with particular focus on houses, roads, and bridges, presenting the reported impacts from the national level to provincial and district levels. The assessment highlights key damage patterns and infrastructure vulnerabilities to support informed recovery, rehabilitation, and reconstruction planning.

Through this assessment, NDMA emphasizes the importance of integrating disaster resilience and climate-adaptive approaches into infrastructure planning, strengthening and maintenance of drainage systems, improving structural and hydraulic design practices, and promoting risk-informed development to reduce future infrastructure losses from recurring monsoon hazards.

2. Summary of Infrastructure Damages

The summary table and graph below present the infrastructure damages incurred across Pakistan during the Monsoon 2026 season.

Table 1: Summary of Infrastructure Damages across Pakistan during Monsoon 2026

Provinces	Roads (km)	Bridges	House Damage		
			Partial	Full	Total
Punjab	0.07	1	123	104	227
KP	4.23	5	345	119	464
Sindh	6	0	38	2	40
Balochistan	0	0	270	18	288
GB	24.61	35	245	290	535
AJ&K	0	0	187	90	277
ICT	0.01	0	8	0	8
Grand Total	34.92	41	1,216	623	1,839

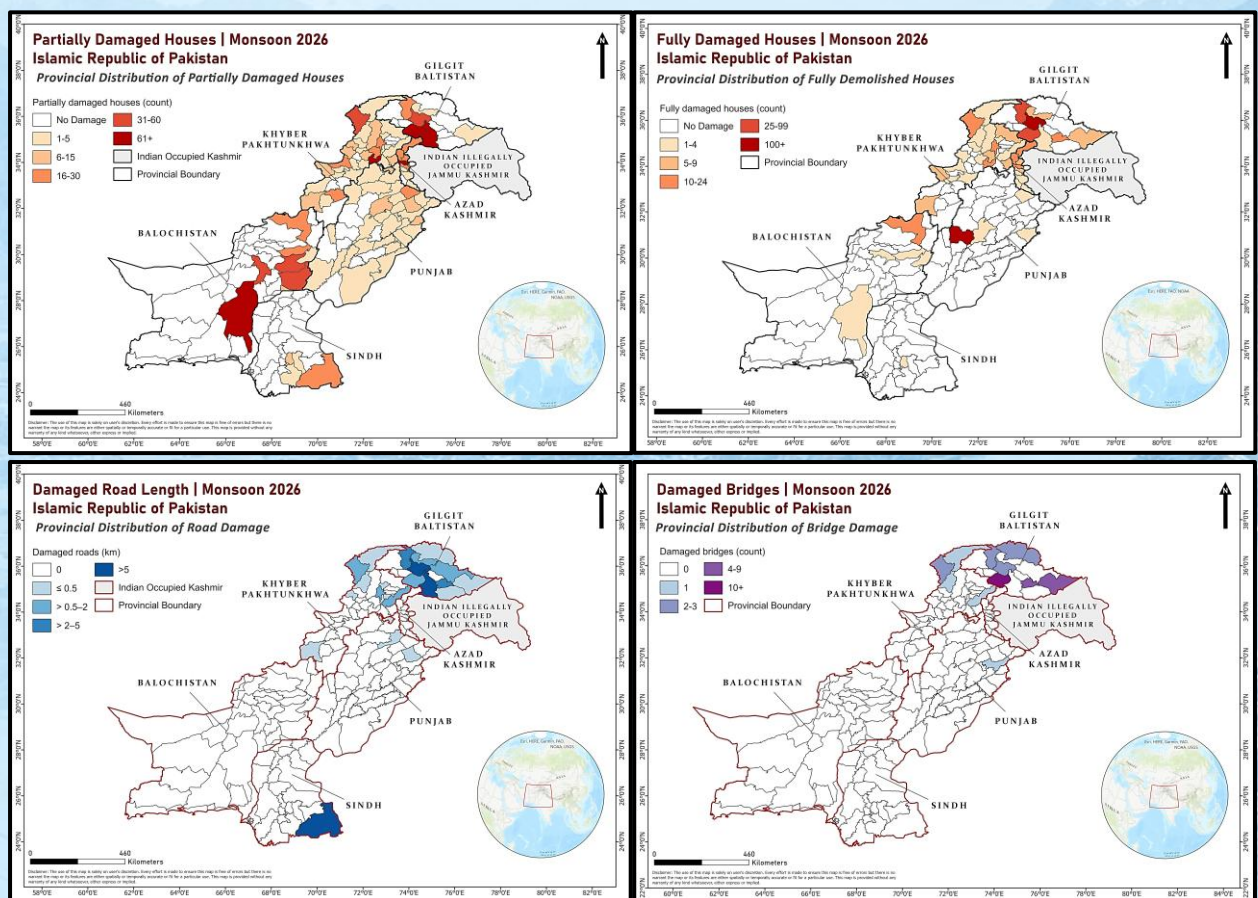


Figure 1: Spatial Distribution of Infrastructural Damages across Districts of Pakistan

3. District-Level Provincial Infrastructure Damage

This section outlines the infrastructure damages recorded across various districts within the provinces of Pakistan during the Monsoon 2026 season.

3.1 Khyber Pakhtunkhwa

3.1.1 Summary of Damages

A comprehensive summary of infrastructure damages across various districts of Khyber Pakhtunkhwa is presented in the table below.

Overview of infrastructure damages in Khyber Pakhtunkhwa			
464	119	4.23km	5
HOUSES DAMAGED	FULLY DAMAGED	ROADS DAMAGED	BRIDGES DAMAGED

Table 2: District-Wise Summary of House Damages in Khyber Pakhtunkhwa (Monsoon 2026)

Sr.	District	House Damage			Sr.	District	House Damage		
		Partial	Full	Total			Partial	Full	Total
1	Abbottabad	8	5	13	17	Malakand	5	0	5
2	Bajaur	14	0	14	18	Mansehra	3	2	5
3	Bar Swat	2	3	5	19	Mardan	11	3	14
4	Batagram	2	5	7	20	Mohmand	13	4	17
5	Buner	30	6	36	21	North Waziristan	1	0	1
6	Chitral Lower	57	22	79	22	Nowshera	2	0	2
7	Chitral Upper	5	3	8	23	Orakzai	1	0	1
8	Upper Kohistan	2	7	9	24	Peshawar	5	0	5
9	Haripur	5	0	5	25	Shangla	21	14	35
10	Hangu	1	1	2	26	South Waziristan	8	8	16
11	Kohat	1	2	3	27	Swabi	77	18	95
12	Kurram	7	6	13	28	Swat	6	1	7
13	Khyber	20	1	21	29	Tank	3	0	3
14	Lakki Marwat	23	0	23	30	Tor Ghar	4	2	6
15	Lower Dir	3	1	4	31	Upper Dir	4	2	6
16	Lower Kohistan	1	3	4					

Table 3: District-Wise Summary of Road Damages in Khyber Pakhtunkhwa (Monsoon 2026)

Sr.	District	Roads (km)	Sr.	District	Roads (km)
1	Bajaur	0.05	7	Mansehra	1.11
2	Bar Swat	0.01	8	Shangla	0.55
3	Batagram	0.05	9	South Waziristan	0.31
4	Chitral Lower	1.42	10	Tor Ghar	0.02
5	Chitral Upper	0.21	11	Upper Dir	0.09
6	Lower Kohistan	0.36	12	Upper Kohistan	0.05

Table 4: District-Wise Summary of Bridge Damages in Khyber Pakhtunkhwa (Monsoon 2026)

Sr.	District	Bridges	Sr.	District	Bridges
1	Chitral Lower	2	2	Chitral Upper	1
3	Mansehra	1	4	Upper Dir	1

3.1.2 Spatial Overview of Damages

The spatial distribution of infrastructure damages during Monsoon 2026 reflects a widespread and geographically diverse impact across Khyber Pakhtunkhwa, with comparatively higher concentrations in the province's mountainous, hilly and flood-prone districts. House damages were particularly prominent in Lower Chitral, Swabi, Shangla, Buner, Khyber, Mohmand and Abbottabad, indicating significant impacts on settlements across both northern mountainous areas and other vulnerable parts of the province. Damage to road infrastructure was mainly concentrated in Lower Chitral, Mansehra, Lower Kohistan and Shangla, where steep terrain, intense runoff, erosion and slope instability can increase the susceptibility of road corridors to monsoon-related hazards.

Bridge damages were reported in Lower Chitral, Upper Chitral, Mansehra and Upper Dir, demonstrating the vulnerability of critical crossings located along rivers, streams and valley drainage systems. Overall, the damage pattern indicates that the northern and north-eastern mountainous districts experienced a relatively higher concentration of transport-infrastructure impacts, while house damages were more broadly distributed across the province. This spatial pattern highlights the need for district-specific resilience measures, particularly improved drainage, slope stabilization, flood protection, resilient road and bridge design, and strengthened pre-monsoon preparedness in high-risk areas.

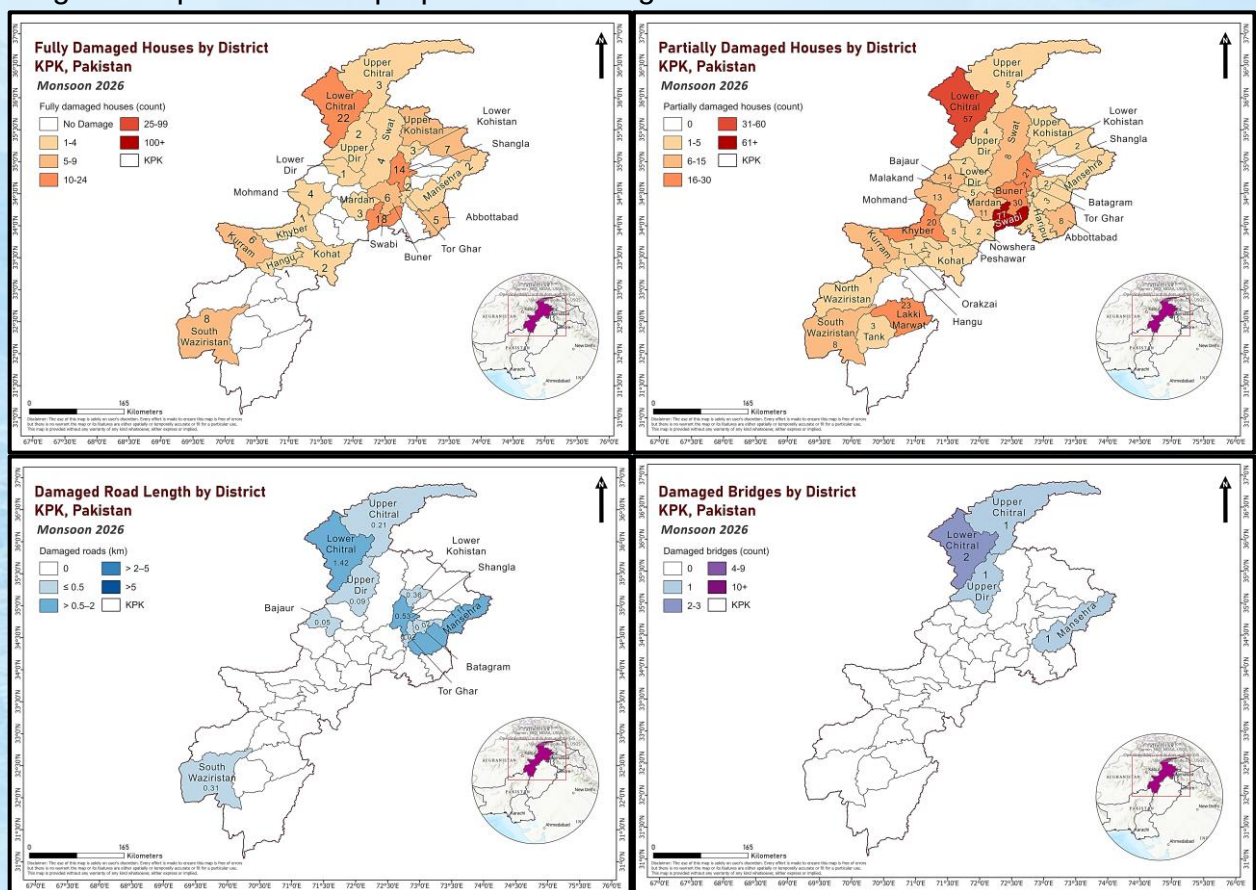


Figure 2: Spatial Distribution of Infrastructural Damages across Districts of Khyber Pakhtunkhwa

3.1.3 Incident Details

INCIDENT - 01 | HEAVY RAINS

Wazir Abad, Tehsil Dargai, District Malakand | Room Collapsed | 16th Aug 2026 | Completely Damaged

STRUCTURAL ASSESSMENT

Structure Type: Adobe Structure. The affected dwelling is an adobe residential structure whose earthen walls and roof are particularly vulnerable to prolonged rainfall and moisture saturation.

Cause: Heavy rainfall saturated and weakened the adobe walls and roof, causing structural collapse. Persistent heavy rainfall increased moisture content in the adobe elements, reducing their strength and leading to failure of the walls and roof.

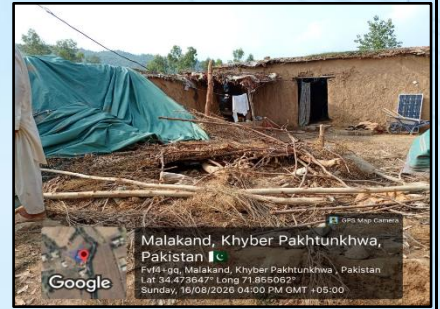
TERRAIN & DEMOGRAPHY

Topography: Hilly and Plain area

Prominent Hazards: Flash Floods, Soil/Bank Erosion, Debris Flow, Earthquake, Landslide. The mixed hilly and plain setting can experience concentrated runoff, erosion and debris movement, while slope instability and seismic hazards increase vulnerability of exposed settlements.

RECOMMENDATION

Reconstruct using stabilized masonry on a raised foundation with a weatherproof roof and proper site drainage. Reconstruction should use moisture-resistant stabilized masonry, elevate the building above local runoff levels, and provide effective roof and site drainage to reduce recurrence of rain-induced damage.



INCIDENT 02 | HEAVY RAIN

Navi Kalay, Tehsil Prang Ghar, District Mohmand | House Damaged | 2nd Aug 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Block Masonry with steel Girder. The affected house comprises block masonry walls with steel girder roof-support elements, making the integrity of wall-girder and roof connections critical to overall stability.

Cause: Inadequate structural connections between the masonry walls, steel girders, and roof allowed the roof to collapse. Weak or inadequate connections permitted roof elements to lose support during rainfall, resulting in roof collapse and associated damage to the masonry structure.

TERRAIN & DEMOGRAPHY

Topography: Hilly and Plain area

Prominent Hazards: Flash Floods, Soil/Bank Erosion, Debris Flow, Earthquake, Landslide. The mixed hilly-plain setting is exposed to runoff, erosion and debris movement, while seismic and landslide hazards can further affect vulnerable residential structures.

RECOMMENDATION

Reconstruct and strengthen the masonry walls with reinforced concrete columns and bond beams at corners and wall junctions. Reinforced concrete columns and bond beams should provide positive confinement and improve wall-to-roof load transfer, particularly at corners and wall junctions.



INCIDENT 03 | HEAVY RAINFALL

Village Majot, UC Nammal, District Abbottabad | House Damaged | 20th July 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Adobe Structure (House)

The affected dwelling is an adobe house in a hilly setting, where earthen construction is particularly susceptible to water ingress, erosion and loss of foundation support.

Cause: Water ingress in roof, slope erosion undermined foundation. Rainwater entered through the roof while slope erosion progressively removed supporting soil, weakening the foundation and contributing to structural distress.

TERRAIN & DEMOGRAPHY

Topography: Hilly area

Prominent Hazards: Heavy Rain, Flash Floods, Soil/Bank Erosion, Debris Flow, Earthquake, Landslide. The hilly terrain concentrates runoff and increases the potential for slope erosion and landslide movement, placing exposed adobe houses at elevated risk during rainfall.

RECOMMENDATION

Stabilize the slope with retaining walls and drainage, strengthen the adobe foundation, and repair the roof with proper waterproofing to prevent future failures. A combined slope-stabilization and drainage solution should control runoff and erosion, while foundation strengthening and roof waterproofing improve the dwelling's resistance to recurrent rainfall.



INCIDENT 04 | HEAVY RAINS

Malgeen, Tehsil Lachi, District Kohat | House Roof Damaged | 14th July 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Steel Girder with Brick and Mud Infills

The house uses a steel girder structural system with brick and mud infill, where adequate roof bearing and water-resistant enclosure are essential for stability.

Cause: Fall of roof due to water ingress. Increase in weight. Low girder bearing at ends. Water ingress increased the roof load and weakened the roof assembly, while insufficient girder bearing at the supports reduced stability and contributed to roof failure.

TERRAIN & DEMOGRAPHY

Topography: Plain area

Prominent Hazards: Heavy Rain, Flash Floods, Soil/Bank Erosion, Debris Flow, Earthquake. The plain setting may experience intense surface runoff and localized flooding; erosion, debris flow and seismic hazards can further affect vulnerable residential construction.

RECOMMENDATION

Use of proper binding material (Cement) for infill to prevent water ingress

Cement-based binding and properly sealed infill can reduce water penetration, improve wall integrity and limit moisture-related deterioration of the roof and masonry system.



INCIDENT 05 | HEAVY RAIN

Chinni Machinkhel, District Tank | Boundary Wall Damaged | 12th July 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Wall of stone and Mud Infill

The affected boundary wall consists of stone masonry with mud infill, a construction type that is vulnerable to moisture saturation, erosion and loss of foundation support.

Cause: Heavy rainfall causing foundation erosion and wall damage

Heavy rainfall increased surface runoff and eroded the supporting ground, reducing wall stability and causing localized damage to the boundary structure.

TERRAIN & DEMOGRAPHY

Topography: Plain area

Hazards: Heavy Rain, Flash Floods, Soil/Bank Erosion, Debris Flow, Earthquake, Landslide

The plain-area setting can receive concentrated runoff and localized flooding; erosion and debris movement may progressively undermine exposed boundary walls and foundations.

RECOMMENDATION

Construct lined surface drains and provide foundation protection to prevent erosion from heavy rainfall. Lined drainage should safely intercept and convey runoff, while foundation protection reduces scour and soil loss around the wall and limits recurrence of erosion-damage.



INCIDENT 06 | HEAVY RAIN

Tehsil Lowi Mamund, District Bajaur | House Roof Damaged | 20th July 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Steel Girder with Brick and Mud Infills

Cause: Fall of roof due to water ingress. Increase in weight. Low girder bearing at ends. Water ingress increased the roof system's weight while the low bearing length at the girder ends reduced support reliability, contributing to roof failure.

TERRAIN & DEMOGRAPHY

Topography: Hilly and Plain area

Prominent Hazards: Heavy Rain, Flash Floods, Soil/Bank Erosion, Debris Flow, Earthquake, Landslide. The mixed hilly–plain setting exposes buildings to intense rainfall, runoff, erosion and slope-related hazards, increasing the demand on vulnerable roof and wall systems.

RECOMMENDATION

Use of proper binding material (Cement) for infill to prevent water ingress and adequate girder bearing at ends. Cement-bound infill should improve resistance to water penetration, while adequate girder bearing length should provide more reliable roof support and load transfer.



3.2 Punjab

3.2.1 Summary of Damages

A comprehensive summary of infrastructure damages across various districts of Punjab is presented in the table below.

Overview of infrastructure damages in Punjab			
227	104	0.07km	01
HOUSES DAMAGED	FULLY DAMAGED	ROADS DAMAGED	BRIDGE DAMAGED

Table 5: District-Wise Summary of House Damages in Punjab (Monsoon 2026)

Sr.	District	House Damage			Sr.	District	House Damage		
		Partial	Full	Total			Partial	Full	Total
1	Attock	5	0	5	17	Mianwali	3	0	3
2	Bahawalnagar	1	0	1	18	Multan	1	0	1
3	Bahawalpur	1	0	1	19	Murree	1	0	1
4	Chakwal	2	0	2	20	Muzaffargarh	4	0	4
5	Chiniot	3	0	3	21	Nankana Sahib	1	0	1
6	Faisalabad	4	0	4	22	Narowal	3	0	3
7	Gujranwala	14	0	14	23	Okara	3	0	3
8	Gujrat	20	1	21	24	Pakpattan	3	0	3
9	Hafizabad	1	0	1	25	Rajanpur	4	0	4
10	Jhang	2	1	3	26	Rawalpindi	1	0	1
11	Jhelum	2	0	2	27	Sahiwal	3	0	3
12	Kasur	4	2	6	28	Sargodha	9	0	9
13	Khanewal	1	0	1	29	Sheikhupura	4	0	4
14	Lahore	11	0	11	30	Sialkot	5	0	5
15	Layyah	0	100	100	31	Toba Tek Singh	1	0	1
16	Mandi Bahauddin	4	0	4	32	Tounsa	2	0	2

Table 6: District-Wise Summary of Road Damages in Punjab (Monsoon 2026)

Sr.	District	Roads (km)
1	Gujranwala	0.01
2	Jhelum	0.06

Table 7: District-Wise Summary of Bridge Damages in Punjab (Monsoon 2026)

Sr.	District	Bridges
1	Sheikhupura	1

3.2.2 Spatial Overview of Damages

The spatial distribution of infrastructure damages across Punjab during Monsoon 2026 indicates a broadly dispersed pattern of impacts, with comparatively higher concentrations in the northern, central and southern districts of the province. House damages were most prominent in Layyah, Gujrat, Gujranwala, Lahore and Sargodha, with additional impacts reported across Attock, Kasur, Mandi Bahauddin, Sialkot, Faisalabad, Rajanpur and other districts. The exceptionally high number of reported house damages in Layyah, comprising 100 fully damaged houses, represents a significant localized concentration and warrants particular attention in the district-level assessment. Damage to transport infrastructure was comparatively limited in the available record, with 0.06 km of road damage in Jhelum and 0.01 km in Gujranwala, while one bridge was damaged in Sheikhupura. Overall, the recorded pattern suggests that the principal infrastructure impact in Punjab was localized residential damage rather than widespread damage to major road and bridge networks, with affected areas distributed across riverine, low-lying and urban/peri-urban settings. The spatial distribution underscores the importance of district-specific flood risk management, protection of vulnerable settlements, improved drainage and floodwater management, and targeted strengthening of critical transport infrastructure, particularly in districts exposed to riverine flooding, intense rainfall and localized inundation during future monsoon events.

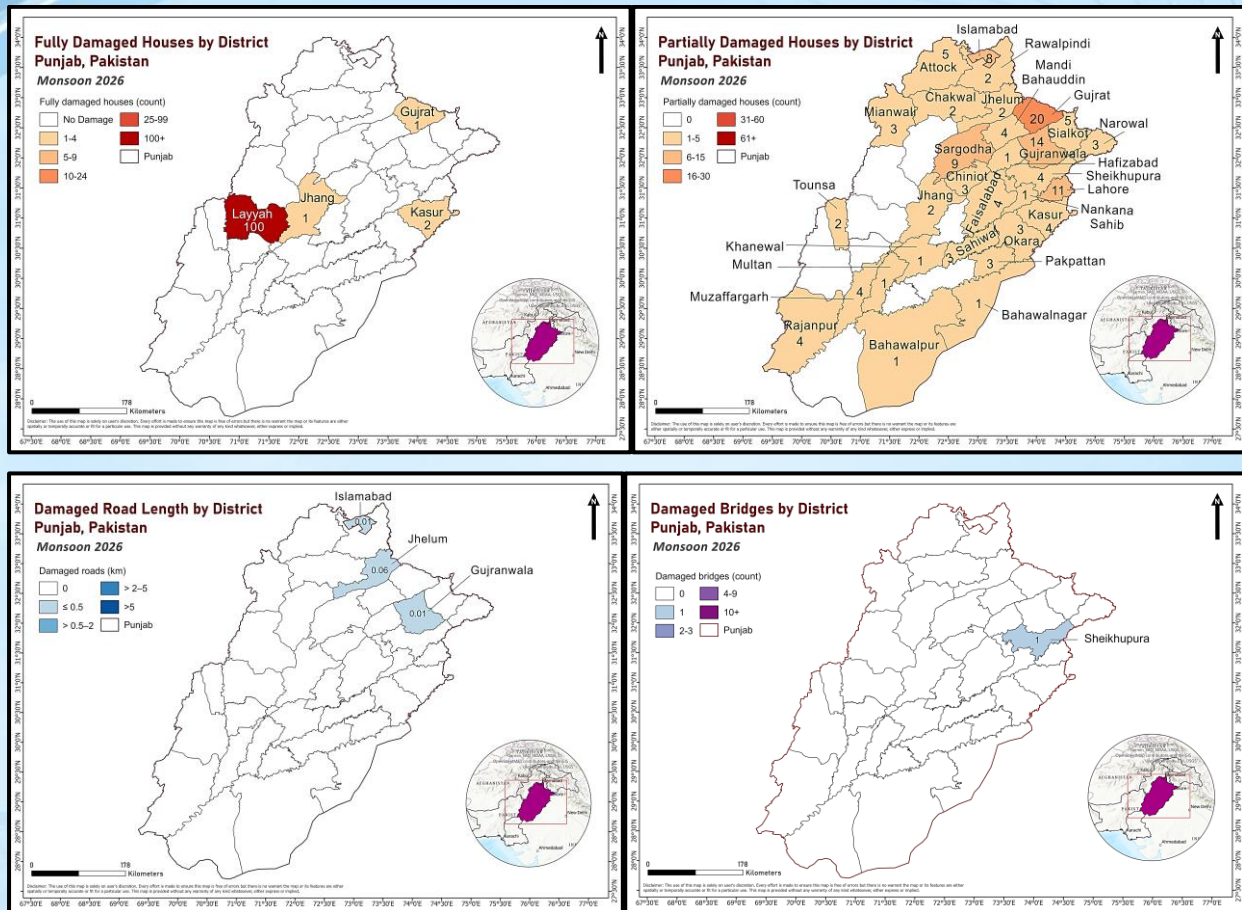


Figure 3: Spatial Distribution of Infrastructural Damages across Districts of Punjab

3.2.3 Incident Details

INCIDENT 01 | RIVER EROSION

Layyah – Punjab | 2x Houses Damaged | 31 Aug 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Adobe roof over unconfined masonry. The affected houses use adobe roofing over unconfined masonry, a vulnerable construction system where loss of confinement and inadequate load transfer can lead to progressive wall and roof failure.

Cause: Inadequate spans with improper distribution of loads, Inadequate supports at ends. The observed deficiencies indicate insufficient structural support and load distribution. Under river-erosion conditions, reduced ground support can further increase the risk of localized structural failure.

TERRAIN & DEMOGRAPHY

Topography: Alluvial Plain

Prominent Hazards: Riverine Floods, Soil/Bank Erosion, Waterlogging, Earthquake. The alluvial-plain setting is naturally susceptible to river migration, bank erosion and waterlogging.

RECOMMENDATION

Provision of adequate spans, Provision of confinement in masonry, Provision of adequate end bearings. The recommended measures improve load transfer, masonry stability and end support. For river-exposed sites, these should be complemented by appropriate bank protection and drainage to limit further foundation undermining.



INCIDENT 02 | WINDSTORM

Sheikhupura – Punjab | House Damage | 26 June 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Residential House. The affected residential structure uses masonry walls with a lightweight adobe roof system supported by timber girders and thatch.

Cause: Adobe roof (Timber Girders supporting Thatch) collapse due to rain. Rainfall increased moisture and weight in the thatch roof while weakening the earthen roof components, contributing to collapse of the timber-supported system.

TERRAIN & DEMOGRAPHY

Topography: Alluvial Plain

Hazards: Riverine Floods, Flash Floods, Soil Erosion, Earthquake

The alluvial plain setting is susceptible to surface-water accumulation and flooding; erosion and seismic hazards can further affect the stability of vulnerable residential structures.

RECOMMENDATION

RC slab with waterproof membrane. Replace the vulnerable thatched roof with a structurally integrated reinforced-concrete slab and waterproof membrane to improve durability and resistance to future rainfall.



INCIDENT 03 | RAINFALL

Gujrat – Punjab | Structure Collapsed | 20 Aug 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Brick and mud infill slab over timber and steel girders. The structure comprises a masonry enclosure supporting a slab/roof system carried by timber and steel girders. Such mixed and aging systems are sensitive to moisture, inadequate bearing and uneven load transfer.

Cause: Over-aged girder structure with inadequate end bearings. Increase in weight due to water ingress. Water ingress increases dead load and weakens moisture-sensitive materials. Combined with inadequate end bearings and an over-aged girder system, this can trigger local or progressive collapse.

TERRAIN & DEMOGRAPHY

Topography: Alluvial Plain

Prominent Hazards: Riverine Floods, Flash Floods, Soil/Bank Erosion, Earthquake. The alluvial-plain setting is exposed to flooding and soil or bank erosion. Moisture-related deterioration can further reduce the capacity of vulnerable roofs and masonry structures.

RECOMMENDATION

Use of proper binding material in roof slab. Use of proper steel girders with adequate end bearings. The recommended measures improve roof-system integrity and load transfer. Adequate girder bearing should be ensured at supports, while proper binding and moisture protection should limit future deterioration and water ingress.



INCIDENT 04 | RAIN

Mandi Bahauddin – Punjab | Houses Damage | 25 July 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Brick Masonry House. The affected houses are brick masonry structures

Cause: The absence of adequate structural reinforcement and confinement in the masonry walls. Insufficient reinforcement and confinement reduced the ability of the masonry walls to maintain a stable load path, contributing to structural distress and partial damage during the rainfall event.

TERRAIN & DEMOGRAPHY

Topography: Alluvial Plain

Prominent Hazards: Urban Flash Floods, Riverine Floods, Waterlogging, Earthquake. The alluvial plain setting is relatively low-lying and susceptible to water accumulation, urban drainage surcharge and flood-related weakening of foundations and masonry.

RECOMMENDATION

Incorporate reinforced concrete tie beams, columns, and proper wall reinforcement. Reconstruction and rehabilitation should provide positive structural confinement through RC columns and tie beams, with properly detailed wall reinforcement to improve integrity and load transfer.



INCIDENT 05 | RAINFALL

Kasur – Punjab | House Collapsed | 9 Aug 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Adobe Structure. The affected dwelling is an adobe structure, which has limited resistance to prolonged moisture exposure and can experience rapid loss of strength when walls and roof elements become saturated.

Cause: Moisture saturation and weakening of adobe. Adobe roof on Timber Girders supported on Bricks with Mud infills. Rainfall moisture can saturate adobe walls and mud infill, reducing their cohesion. The timber-girder roof and brick-supported arrangement can become unstable when the supporting masonry weakens.

TERRAIN & DEMOGRAPHY

Topography: Alluvial Plain

Prominent Hazards: Riverine Floods, Flash Floods, Soil/Bank Erosion, Waterlogging. The alluvial plain is exposed to floodwater, waterlogging and soil or bank erosion. Saturated ground and prolonged wetting can further reduce the stability of vulnerable adobe construction.

RECOMMENDATION

Improve waterproofing and roof drainage, provide roof-to-wall bracing, raise plinth and provide DPC. Improved roof drainage and waterproofing will limit moisture ingress; roof-to-wall bracing will improve load transfer, while a raised plinth and DPC will reduce rising damp and flood-related moisture damage.



INCIDENT 06 | RAINFALL

Chakwal – Punjab | House Roof Collapsed | 1 Aug 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Brick Masonry House. The affected residential building is constructed in brick masonry, with the roof-supporting system particularly vulnerable to prolonged moisture exposure and deterioration.

Cause: Prolonged rainfall causing water infiltration, weakening the roof-supporting masonry and leading to structural failure. Persistent rainfall allowed water ingress into the roof and supporting masonry, reducing material strength and contributing to localized roof collapse.

TERRAIN & DEMOGRAPHY

Topography: Hilly

Hazards: Earthquake, Flash Floods, Landslides, Soil Erosion. The hilly setting is exposed to runoff and soil erosion, while flash floods, landslides and seismic loading can further increase vulnerability of residential structures.

RECOMMENDATION

Confined Block Masonry. RC slab with waterproof membrane. Reconstruction should improve structural confinement and provide a durable, water-resistant roof system to prevent recurrence of rain-induced deterioration and failure.



3.3. Balochistan

3.3.1. Summary of Damages

A comprehensive summary of infrastructure damages across various districts of Balochistan is presented in the table below.

Overview of infrastructure damages in Balochistan			
288	18	0km	0
HOUSES DAMAGED	FULLY DAMAGED	ROADS DAMAGED	BRIDGES DAMAGED

Table 8: District-Wise Summary of House Damages in Balochistan (Monsoon 2026)

Sr.	District	House Damage		
		Partial	Full	Total
1	Barkhan	2	2	4
2	Dera Bugti	40	0	40
3	Duki	18	1	19
4	Harnai	0	1	1
5	Kachhi	50	0	50
6	Kohlu	50	0	50
7	Khuzdar	78	1	79
8	Sohbatpur	10	0	10
9	Zhob	22	13	35

3.3.2. Spatial Overview of Damages

The spatial distribution of infrastructure damages in Balochistan during Monsoon 2026 remained largely localized and concentrated in selected districts, with impacts reported primarily on residential structures. The highest house damages were recorded in Khuzdar (79), Kachhi (50), Kohlu (50), Dera Bugti (40) and Zhob (35), indicating greater vulnerability of settlements to intense rainfall, flash flooding and localized runoff. No damage to roads or bridges was reported during the assessment period. Overall, the recorded pattern indicates that the monsoon impacts were primarily settlement-level and localized, highlighting the need

for targeted measures including flood-resilient housing, improved local drainage, early warning and district-level preparedness, particularly in vulnerable and remote areas.

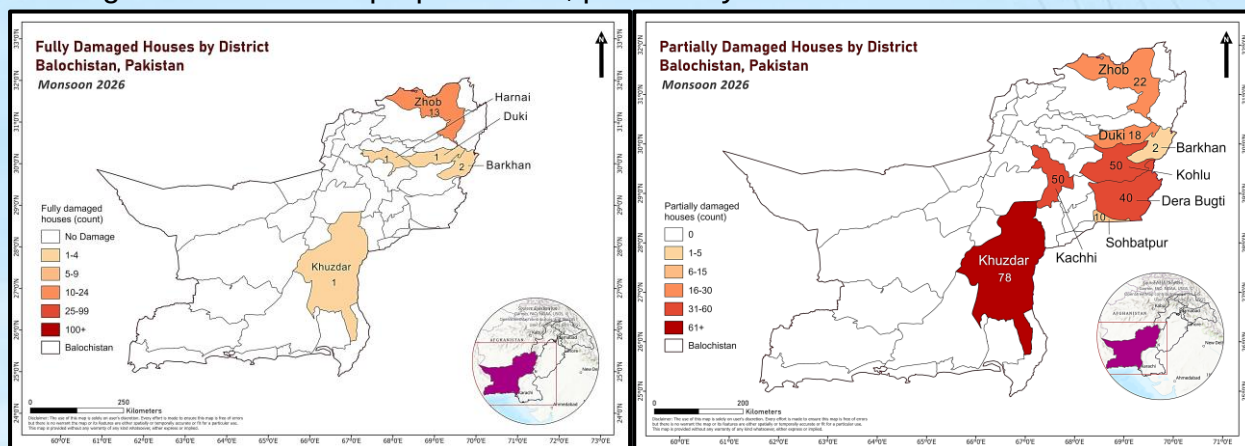


Figure 4: Spatial Distribution of Infrastructural Damages across Districts of Balochistan

3.3.3. Incident Details

INCIDENT 01 | HEAVY RAIN

Tehsil-Kohlu | Houses Damaged | 23 July 2026 | Fully Damaged

STRUCTURAL ASSESSMENT

Structure Type: Adobe House

Cause: Water saturation and erosion weakened adobe load-bearing walls and foundations, causing collapse. The adobe residential structure experienced progressive weakening of its load-bearing walls and foundations under prolonged water exposure and erosion, resulting in structural collapse.

TERRAIN & DEMOGRAPHY

Topography: Valley Floor

Prominent Hazards: Floods, Earthquake. The valley-floor setting contains residential development that remains vulnerable where earthen construction is exposed to saturation, erosion and seismic effects.

RECOMMENDATIONS

Reconstruct using confined adobe construction with wire mesh or polymer geomesh, tie columns, stabilized adobe blocks. The proposed reconstruction approach should improve confinement and wall stability while reducing the vulnerability of adobe components to future deterioration.



INCIDENT 02 | EARTHQUAKE

Tehsil-Kinari, Musakhel | Approx. 90 Houses Damaged | 13 July 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Adobe House

Cause: Failure of unreinforced adobe load-bearing walls, without any seismic bands, or lateral confinement, leading to progressive roof collapse. The absence of seismic bands and lateral confinement left the adobe load-bearing walls vulnerable to earthquake-induced lateral forces, resulting in wall instability and progressive roof collapse.

TERRAIN & DEMOGRAPHY

Topography: Intermontane Valley

Tectonic Plates: Indian Plate, Eurasian Plate



Prominent Hazards: Earthquake. The intermontane setting lies within an active tectonic environment where seismic loading can impose significant lateral demand on vulnerable earthen structures.

RECOMMENDATIONS

Reconstruct using confined adobe construction with wire mesh or polymer geomesh, tie columns, stabilized adobe blocks. Reconstruction should use confined adobe techniques and improved connections to enhance wall integrity, seismic performance and overall structural resilience.



INCIDENT 03 | HEAVY RAIN

Tehsil-Zhob | 22 Houses Damaged | 21–22 July 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Stone Masonry House (Mud Mortar)

Cause: Saturation of mud mortar caused out-of-plane wall failure, leading to roof collapse. Prolonged water saturation weakened the mud-mortar joints and reduced wall stability, resulting in out-of-plane failure and subsequent roof collapse.

TERRAIN & DEMOGRAPHY

Topography: Intermontane Valley

Prominent Hazards: Floods, Earthquake. The intermontane valley setting contains settlements exposed to seismic effects, while water-sensitive masonry construction can experience increased vulnerability during heavy rainfall.

RECOMMENDATIONS

Reconstruct using confined stone masonry with cement mortar, RC or Timber bands, ties columns. Reconstruction should introduce confinement and positive wall-to-wall/roof connections to improve stability and reduce vulnerability to future lateral and seismic loading.



INCIDENT 04 | HEAVY RAIN

Tehsil-Zhob | 13 Houses Damaged | 21–22 July 2026 | Fully Damaged

STRUCTURAL ASSESSMENT

Structure Type: Adobe structure

Cause: Water saturation weakened unreinforced mud walls with minimal stone or brick masonry, causing wall failure and progressive roof collapse. Prolonged water saturation reduced the strength and stability of the unreinforced earthen walls, resulting in wall failure and progressive roof collapse.

TERRAIN & DEMOGRAPHY

Topography: Intermontane Valley

Prominent Hazards: Floods, Earthquake. The intermontane valley setting is exposed to seismic hazards, while earthen and lightly reinforced residential construction presents elevated structural vulnerability.

RECOMMENDATIONS

Reconstruct using confined stone masonry with cement mortar, RC or Timber bands, ties columns

Reconstruction should provide confinement, improved mortar and positive structural ties to increase wall stability and improve resistance to future lateral and seismic forces.



INCIDENT 05 | THUNDER & WINDSTORM

Musakhel-Washuk | Wall Collapse | 12 July 2026 | Fully Damaged

STRUCTURAL ASSESSMENT – ELECTRIC POLE

Structure Type: Electric Pole

Cause: High wind loads and saturated soil caused structural foundation overturning (design failure of foundation)

Recommendations: Deep foundation should be provided

Wind-induced lateral loading combined with reduced soil strength from saturation contributed to foundation instability and overturning. The foundation system should be designed for governing wind and soil conditions.

MITIGATION MEASURES – ELECTRIC POLE

Deeper, micro-piled concrete foundations to withstand lateral storm forces

A deeper micro-piled foundation can transfer lateral and overturning forces to more competent soil strata and improve stability under severe storm loading.

ASSESSMENT STATUS: PARTIALLY DAMAGED



3.4. Sindh

3.4.1. Summary of Damages

A comprehensive summary of infrastructure damages across various districts of Sindh is presented in the table below.

Overview of infrastructure damages in Sindh			
40	2	6km	0
HOUSES DAMAGED	FULLY DAMAGED	ROADS DAMAGED	BRIDGES DAMAGED

Table 9: District-Wise Summary of House and Roads Damages in Sindh (Monsoon 2026)

Sr.	District	House Damage		
		Partial	Full	Total
1	Badin	1	0	1
2	Mirpur Khas	3	0	3
3	Tando Allahyar	8	2	10
4	Tharparkar	26	0	26

Sr.	District	Roads (km)
1	Tharparkar	6

3.4.2. Spatial Overview of Damages and Incident Details

During the early August 2026 monsoon, structural impacts across Sindh were confined to highly localized pockets in Tando Allahyar, Tharparkar, Badin, and Mirpur Khas, resulting in two fully collapsed structures and 38 partially damaged homes. These isolated incidents exclusively affected vulnerable housing stock, primarily unreinforced masonry, semi-pakka units, and traditional adobe structures. The events were driven by intense, localized downpours interacting with specific terrains rather than widespread regional flooding

The structural failures across these events were primarily caused by prolonged basal moisture ingress, hydraulic scour, and the extreme saturation of informal roofing materials. Stagnant surface water caused deep subgrade soil saturation, which stripped shallow foundations of their bearing capacity and led to differential settlement and wall cracking in semi-pakka buildings. Additionally, capillary action and sudden hydraulic scour, exacerbated

in one instance by 15-foot and 8-foot breaches in Badin's Mirwah Canals, severely eroded the unreinforced mud-mortar joints and earthen bases of traditional walls. Overhead, the high-intensity downpours exceeded the moisture absorption limits of traditional thatched and timber canopies, triggering direct roof cave-ins due to the heavy dead-weight of the saturated materials.



Figure 5: Location: Tharparkar, Event: Rainfall / Lightening

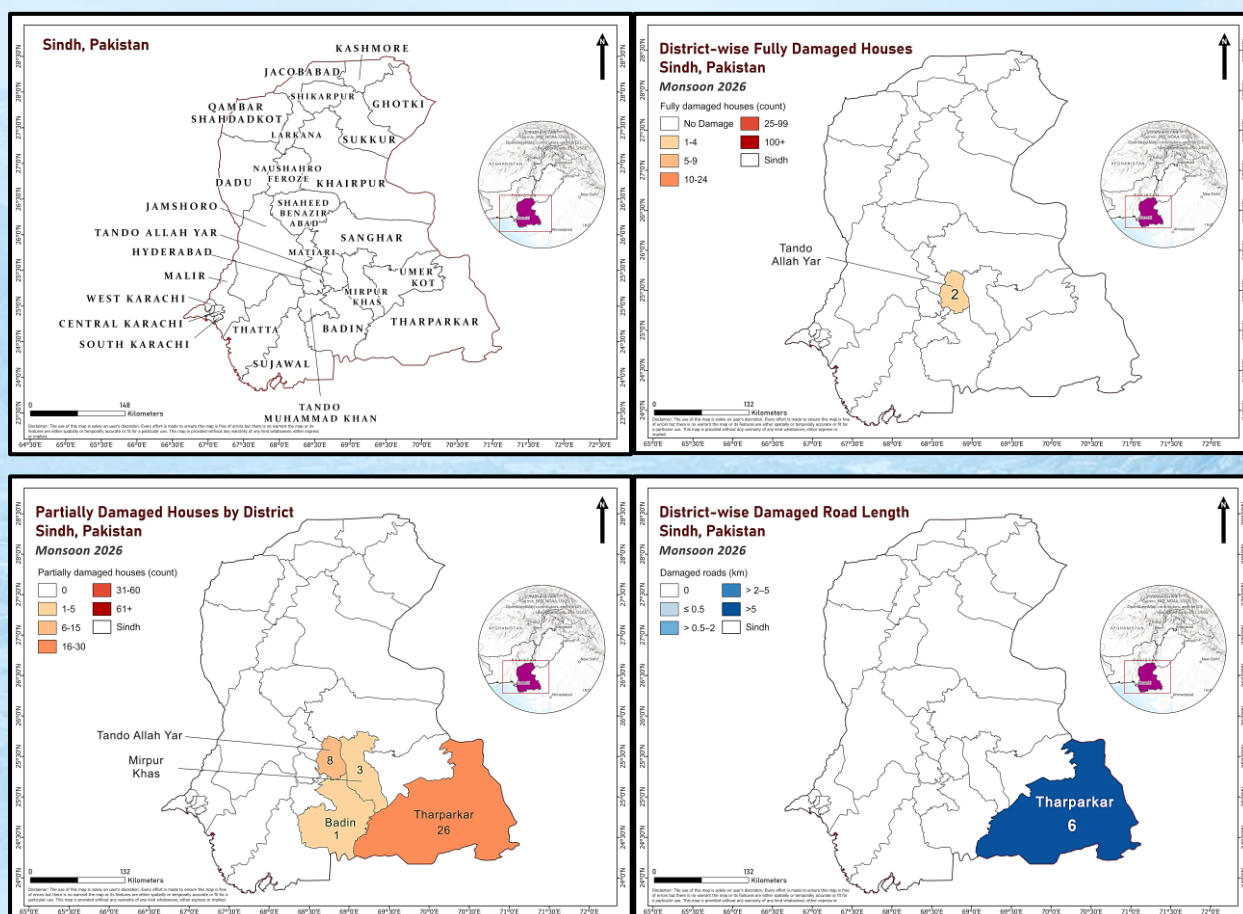


Figure 6: Spatial Distribution of Infrastructural Damages across Districts of Sindh

3.5. Gilgit Baltistan

3.5.1. Summary of Damages

A comprehensive summary of infrastructure damages across various districts of Gilgit Baltistan is presented in the table below.

Overview of infrastructure damages in Gilgit Baltistan			
535	290	24.61km	35
HOUSES DAMAGED	FULLY DAMAGED	ROADS DAMAGED	BRIDGES DAMAGED

Table 10: District-Wise Summary of House Damages in Gilgit Baltistan (Monsoon 2026)

Sr.	District	House Damage			Sr.	District	House Damage		
		Partial	Full	Total			Partial	Full	Total
1	Astore	84	1	85	5	Gilgit	42	113	155
2	Diamir	85	77	162	6	Nagar	2	5	7
3	Ghanche	4	9	13	7	Skardu	0	18	18
4	Ghizer	28	67	95					

Table 11: District-Wise Summary of Road Damages in Gilgit Baltistan (Monsoon 2026)

Sr.	District	Roads (km)	Sr.	District	Roads (km)
1	Astore	7	7	Hunza	0.39
2	Chilas	0.1	8	Kharmang	0.22
3	Diamir	2	9	Nagar	0.96
4	Ghanche	0.4	10	Shigar	1
5	Ghizer	4.1	11	Skardu	3.32
6	Gilgit	5.12			

Table 12: District-Wise Summary of Bridge Damages in Gilgit Baltistan (Monsoon 2026)

Sr.	District	Bridges	Sr.	District	Bridges
1	Diamir	12	4	Gilgit	2
2	Ghanche	7	5	Hunza	3
3	Ghizer	3	6	Skardu	8

3.5.2. Spatial Overview of Damages

The spatial pattern of infrastructure damages in Gilgit-Baltistan during Monsoon 2026 shows a high concentration of impacts in mountainous districts and river-valley settlements, where steep slopes, active river channels and limited transport corridors increase vulnerability to monsoon hazards. Diamir recorded the highest overall impact, with 162 damaged houses, 2 km of road damage and 12 damaged bridges. Gilgit was the second major damage hotspot, reporting 155 damaged houses, 5.12 km of road damage and 2 damaged bridges. Significant impacts were also recorded in Ghizer and Astore, with 95 and 85 damaged houses and 4.1 km and 7 km of road damage, respectively. Bridge damage was particularly notable in Diamir, Skardu and Ghanche, where 12, 8 and 7 bridges were damaged.

Overall, the distribution indicates that Monsoon 2026 caused both residential and critical transport infrastructure damages, with the most affected areas concentrated along river corridors, steep mountainous terrain and vulnerable road networks. The observed damage pattern is consistent with exposure to flash floods, riverbank erosion, debris flows, slope failures and high surface runoff. Diamir, Gilgit, Ghizer, Astore and Skardu therefore emerge as key spatial priority areas for infrastructure resilience. Future mitigation should focus on

riverbank protection, slope stabilization, improved drainage, resilient bridge design, protection of critical road corridors and strengthened early-warning and pre-monsoon preparedness measures.

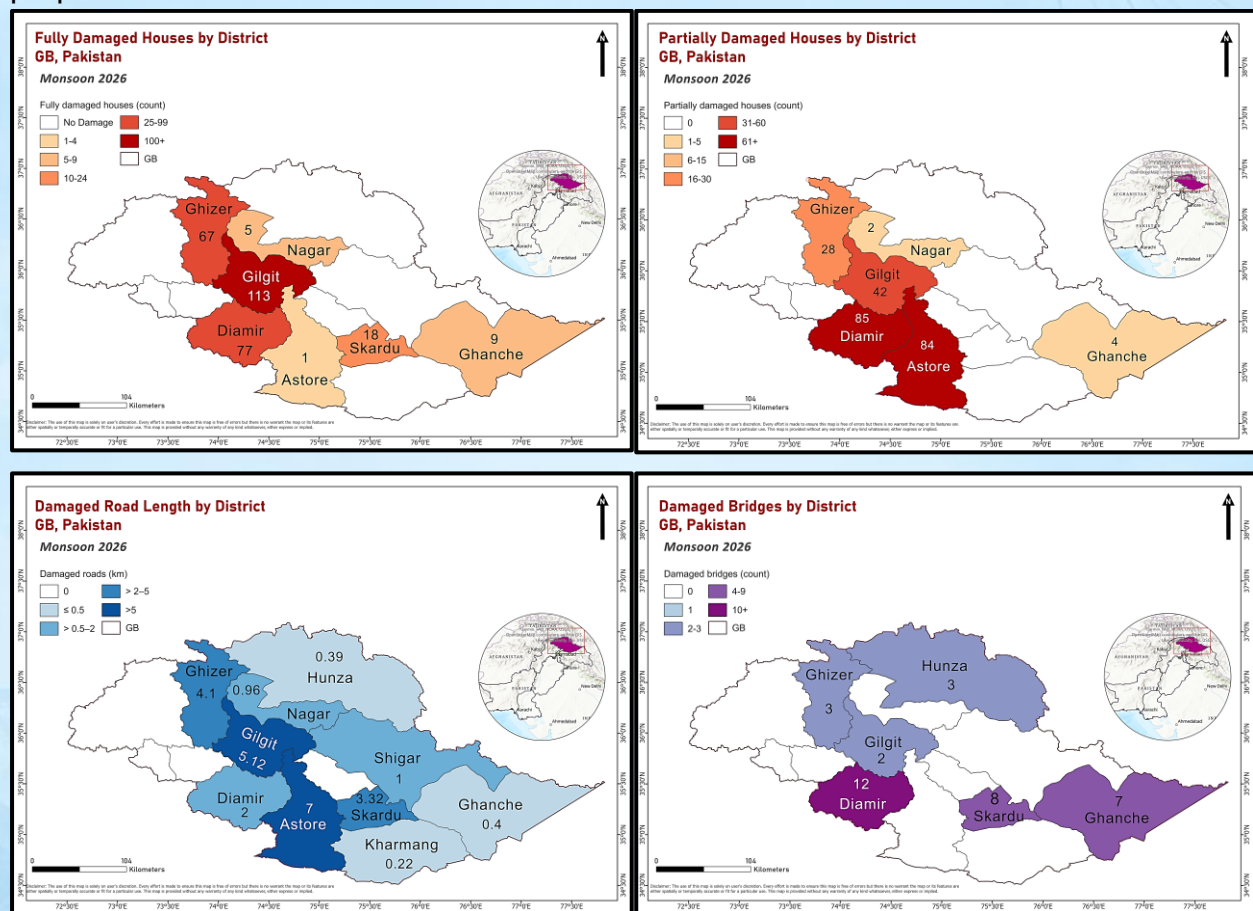


Figure 7: Spatial Distribution of Infrastructural Damages across Districts of Gilgit-Baltistan

3.5.3. Incident Details

INCIDENT 01 | FLASH FLOOD

Gilgit – Skardu Road | Bridge Washed Away | 26th July, 2026 | Fully Damaged

STRUCTURAL ASSESSMENT

Structure Type: Residential House (Stone Masonry/RCC), Concrete-Lined Irrigation Water Channel.

Cause: Flood Water overtopped the Water Channel, causing Inundation of nearby Houses. Damaged to Irrigation Channel. The observed failure indicates that the flood flow exceeded the effective capacity of the channel and caused damage to the channel infrastructure.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley with Agricultural Terraces.

Main Water Channel: Jaglot Seasonal Flood Channel.

Prominent Hazards: Landslides, Flash Floods, Channel Overtopping, Debris Flow, Landslide, Hydraulic Scour.

RECOMMENDATION

Construct RCC Flood Protection Walls, Raise Channel Walls. These measures are intended to improve flood containment and reduce the likelihood of future overtopping and inundation of nearby properties.



INCIDENT 02 | FLOOD

Jaglot – Gilgit | House, Water Channels, Damaged | 25th July, 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Residential House (Stone Masonry/RCC), Concrete-Lined Irrigation Water Channel.

The affected assets comprise a residential structure and a concrete-lined irrigation water channel exposed to floodwater and associated flow impacts.

Cause: Flood Water overtopped the Water Channel, causing Inundation of nearby Houses. Damaged to Irrigation Channel. Channel overtopping allowed floodwater to enter nearby residential areas, while the channel itself sustained damage from the flood flow.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley with Agricultural Terraces.

Main Water Channel: Juglote Seasonal Flood Channel.

Prominent Hazards: Landslides, Flash Floods, Channel Overtopping, Debris Flow, Landslide, Hydraulic Scour.

RECOMMENDATION

Construct RCC Flood Protection Walls, Raise Channel Walls. Flood protection walls and increased channel wall height can improve flow containment and reduce the risk of future overtopping and inundation of adjacent houses.



INCIDENT 03 | FLOOD

Khaplu – Ghanche | Damaged to Road, RCC Bridge | 23rd July, 2026 | Partially Damaged / Bridge Under Threat

STRUCTURAL ASSESSMENT

Structure Type: Reinforced Concrete (RCC) Bridge with Asphalt Road.

The RCC bridge and connected asphalt road form a critical transport link exposed to direct flood and erosion effects.

Cause: Flash Flood Discharge caused Hydraulic Scour & Erosion. Damaged to Road & Bridge. High-velocity floodwater caused scour and erosion around the road and bridge, reducing the stability of the approach and threatening the crossing.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley.

Prominent Hazards: Flash Floods, Landslides, Rockfall, Debris Flow, Riverbank Erosion, Hydraulic Scour. The steep mountain setting and seasonal channel create concentrated flow conditions, with multiple slope and hydraulic hazards affecting the road corridor and bridge.

RECOMMENDATION

Gabion Mattresses around Bridge Abutments, RipRap Scour Protection.

Gabion mattresses and riprap protection should reduce local scour, protect bridge abutments and improve resilience against future high-flow events.

ASSESSMENT STATUS: **PARTIALLY DAMAGED – BRIDGE UNDER THREAT**



INCIDENT 04 | FLOOD

Marcha Bridge – Ghanche | Riverbank Erosion due to Continuous Rainfall | 22nd July, 2026 | High Risk of Failure

STRUCTURAL ASSESSMENT

Structure Type: Single - Lane, Steel Bailey Bridge.

The single-lane Bailey bridge is a critical crossing whose approach and supporting ground are exposed to ongoing riverbank erosion and hydraulic action.

Cause: Continuous Overnight Rainfall. Increase the Discharge in Shyok River. Resulted in the Severe Local Scour. Continuous rainfall increased river discharge, producing severe local scour around the bridge approach and riverbank and substantially increasing the risk of failure.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley.

Main River Channel: Shyok River.

Prominent Hazards: Flash Floods, Riverbank Erosion, Hydraulic Scour, Debris Flow, Earthquake, Rockfall.

The steep mountain valley and active Shyok River corridor expose the crossing to strong hydraulic forces, erosion and debris movement, with additional seismic and rockfall hazards.

RECOMMENDATION

Install Stepped Gabion Protection. Stepped gabion protection should be provided at vulnerable riverbank and bridge approach sections to control erosion, dissipate flow energy and protect against progressive scour.

ASSESSMENT STATUS: HIGH RISK OF FAILURE



INCIDENT 05 | WATER LEVEL INCREASE

Hamuchal Bridge – Ghizer | Bridge Abutment Damage | 5th July, 2026 | Partially Damaged

STRUCTURAL ASSESSMENT

Structure Type: Single Lane Suspension Bridge with Reinforced Concrete Deck Support. The single-lane suspension bridge is supported by reinforced concrete deck elements, with the bridge abutment area exposed to increased river discharge and scour.

Cause: Increased River Discharge caused Hydraulic Scour. Erosion around Bridge Abutment. Increased water level and flow velocity produced hydraulic scour and erosion around the bridge abutment, reducing support conditions and contributing to partial damage.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley.

Main River Channel: Ghizer River.

Prominent Hazards: Flash Floods, Riverbank Erosion, Hydraulic Scour, Debris Flow, Earthquake, Rockfall. The steep mountain valley and active river corridor expose the bridge to rapid flood flows, bank erosion and scour, with additional debris, seismic and rockfall hazards.

RECOMMENDATION

Restore Bridge using Compacted Granular Fill, Install RipRaps. Compacted granular fill should reinstate and stabilize the affected approach/support area, while riprap protection should limit further scour and erosion around the bridge abutment.



INCIDENT 06 | FLASH FLOOD

Shaiten Nullah, Thore | House Damages – Water Channels Damaged | 27th June, 2026 | Partially-Fully Damaged

STRUCTURAL ASSESSMENT

Structure Type: Residential Houses (RCC/ Concrete Masonry).

The affected residential houses are located adjacent to a narrow seasonal drainage channel and were exposed to direct floodwater and debris impacts.

Cause: Intense Flash Flooding in Shaiten Nullah Caused the Water Channel to Overflow towards Residential Areas. The intense flash flood caused the channel to overflow toward the settlement, resulting in inundation and damage to residential property and channel infrastructure.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley with Narrow Channel.

Main River Channel: Shaitan Nullah.

Prominent Hazards: Flash Floods, Riverbank/Nullah Erosion, Debris Flow, Earthquake, Rockfall, Landslide.

The steep terrain and narrow nullah can rapidly concentrate runoff, while erosion, debris movement and slope instability increase exposure of nearby houses.

RECOMMENDATION

Construct RCC Retaining Walls, Gabion Retaining Structures.

RCC retaining walls and gabion structures should provide channel-side protection, stabilize vulnerable banks and reduce the likelihood of future floodwater encroachment into residential areas.



INCIDENT 07 | FLASH FLOOD

Hodur Valley – Diamer | Houses, Bridges, Road Infrastructure Damaged | 28th July, 2026 | Partially–Fully Damaged

STRUCTURAL ASSESSMENT

Structure Type: Residential House (Stone Masonry/RCC), Concrete-Lined Irrigation Water Channel.

Cause:

- Flood Water overtopped the Water Channel, causing Inundation of nearby Houses.
- Damaged to Irrigation Channel.

Flash-flood discharge exceeded the capacity of the concrete-lined channel, causing overtopping and inundation of adjacent houses. Channel damage can further reduce conveyance and protection during subsequent events.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley with Agricultural Terraces.

Main Water Channel: Juglote Seasonal Flood Channel.

Hazards: Landslides, Flash Floods, Channel Overtopping, Debris Flow, Landslide, Hydraulic Scour.

The steep mountain valley and seasonal flood channel concentrate rapid runoff and debris movement, increasing exposure of nearby settlements and infrastructure to overtopping, scour and erosion.

RECOMMENDATION

Construct RCC Flood Protection Walls, Raise Channel Walls.

RCC flood-protection walls and increased channel wall height can improve flood containment and reduce the likelihood of overtopping and direct inundation of nearby houses.

ASSESSMENT STATUS: PARTIALLY–FULLY DAMAGED



3.6. Azad Jammu and Kashmir

3.6.1. Summary of Damages

A comprehensive summary of infrastructure damages across various districts of Azad Jammu and Kashmir is presented in the table below.

Overview of infrastructure damages in AJ&K			
277	90	0	0
HOUSES DAMAGED	FULLY DAMAGED	ROADS DAMAGED	BRIDGES DAMAGED

Table 13: District-Wise Summary of House Damages in AJ&K (Monsoon 2026)

Sr.	District	House Damage			Sr.	District	House Damage		
		Partial	Full	Total			Partial	Full	Total
1	Bagh	83	17	100	6	Mirpur	0	3	3
2	Bhimber	2	3	5	7	Muzaffarabad	24	13	37
3	Haveli	7	21	28	8	Neelum Valley	21	15	36
4	Jhelum Valley	16	6	22	9	Poonch	29	8	37
5	Kotli	1	1	2	10	Sudhnoti	4	3	7

3.6.2. Spatial Overview of Damages

The spatial distribution of house damages in Azad Jammu & Kashmir during Monsoon 2026 shows a clear concentration of impacts in the hilly and mountainous districts, with the severity varying significantly from district to district. Bagh was the most affected district, with 100 damaged houses, including 83 partially and 17 fully damaged houses. Muzaffarabad and Poonch each recorded 37 damaged houses, followed by Haveli (28), Neelum (36), and Jhelum Valley (22). Comparatively lower damages were recorded in Bhimber (5), Sudhnoti (7), Mirpur (3), and Kotli (2).

The overall pattern indicates that Monsoon 2026 damages were mainly concentrated in areas with steep terrain, narrow valleys and vulnerable settlements. The relatively high proportion of fully damaged houses in Haveli, Muzaffarabad and Bagh indicates areas requiring focused structural and hazard assessment. The findings emphasize the need for risk-sensitive settlement planning, slope stabilization, improved drainage, flood protection and climate-resilient housing construction to reduce future monsoon-related losses across AJ&K.

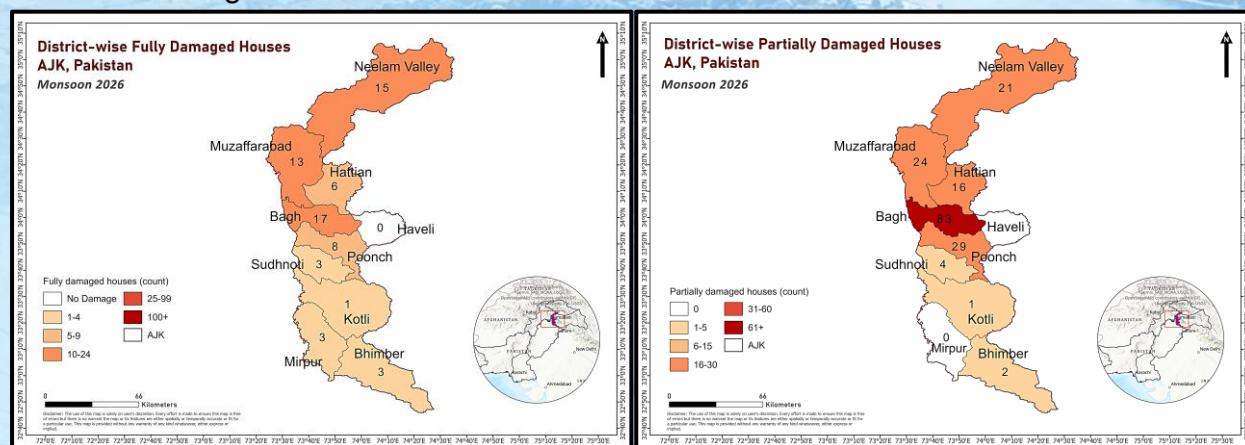


Figure 8: Spatial Distribution of Infrastructural Damages across Districts of Azad Jammu & Kashmir

3.6.3. Incident Details

INCIDENT 01 | LANDSLIDE

Neelum Valley – AJ&K | Road Structure Damaged | 21st July 2026 | Road Damaged

STRUCTURAL ASSESSMENT

Structure Type: Two-Lane Mountain Road (Flexible Pavement with Cut Slope).

The road traverses a steep mountainous corridor with a cut slope, making the pavement and roadside formation directly exposed to slope instability and debris movement.

Cause: Heavy Rainfall triggered a Landslide, depositing Debris & Mud on to the Roadway.

Damaging the Road Infrastructure. Intense rainfall increased slope saturation and reduced shear strength, triggering a landslide that deposited mud and debris on the carriageway and obstructed/damaged the road infrastructure.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley with Dense Forest Cover

Main Adjacent Drainage: Neelum River.

Prominent Hazards: Flash Floods, Landslides, Slope Failure, Debris Flow, Earthquake. The steep, forested valley contains unstable slopes and confined drainage pathways. Rainfall can rapidly mobilize slope debris and intensify erosion along the river corridor.

RECOMMENDATION

Gabion Retaining Walls to Stabilize Slope, & Rockfall Protection Mesh. Stabilize the exposed cut slope using properly founded gabion retaining structures and rockfall mesh, supported by effective surface/subsurface drainage to reduce saturation and recurrent failures.



INCIDENT 02 | LANDSLIDE

Kotli – AJ&K | Road Structure Damaged | 21st July 2026 | Road Damaged

STRUCTURAL ASSESSMENT

Structure Type: Two-Lane Mountain Road (Flexible Pavement with Rock Cut Slope).

The road follows a steep mountainous alignment with a rocky cut slope, leaving the carriageway exposed to rockfall and slope instability.

Cause: Heavy Rainfall Triggered a Rockfall/Landslide, Depositing Large Boulders onto the Roadway with Obstructing Traffic. Intense rainfall saturated and destabilized the rocky slope, triggering rockfall/landslide movement and depositing large boulders on the roadway, thereby obstructing traffic and damaging road infrastructure.

TERRAIN & HAZARDS

Topography: Steep Mountain Valley with Rocky Cut Slope.

Main Adjacent Drainage: Seasonal Mountain Stream.

Hazards: Landslide, Rockfall, Slope Failure, Debris Flow, Earthquake, Soil Erosion.

The steep valley and exposed rock cuts create a high susceptibility to rainfall-induced slope failure, rockfall and debris movement, particularly near drainage channels.

RECOMMENDATION

Provide Rock Bolts & Rock Anchors; Rockfall Catch Barriers.

Stabilize unstable rock masses using engineered rock bolts/anchors and install catch barriers or protective systems to intercept falling boulders before they reach the roadway.



INCIDENT 03 | LANDSLIDE

Rawalakot – Poonch | Road Structure Damaged | 21st July, 2026 | Road Damaged

STRUCTURAL ASSESSMENT

Structure Type: Two-Lane Mountain Road (Flexible Pavement with Cut Slope).

The road is a two-lane mountain corridor with a cut slope, making the pavement and roadside vulnerable to slope instability and debris impact.

Cause: Rainfall triggered a Landslide, depositing Large Boulders & Debris onto the Roadway. Resulting in Road Blockage.

Intense rainfall destabilized the cut slope, mobilizing boulders and debris onto the carriageway and obstructing road traffic.

TERRAIN & HAZARDS

Topography: Steep Mountain Terrain with Cut Slope.

Main Adjacent Drainage: Seasonal Mountain Stream.

Hazards: Landslide, Slope Failure, Debris Flow, Earthquake, Flash Floods, Erosion.

The steep cut-slope terrain and nearby seasonal drainage concentrate runoff and increase the likelihood of landslides, rockfall, erosion and debris movement.

RECOMMENDATION

Catch Water Drains to Stabilize the Slope & Protect Road from Future Landslides.

Catch-water drains should intercept and safely divert runoff above the cut slope, reducing water infiltration and helping prevent recurrent slope failures and road blockage.



INCIDENT 04 | CLOUDBURST

Village Kathan Peeran, Neelum Valley – AJ&K | Damage to Residential Houses & Infrastructure | 19th July 2026 | Residential & Infrastructure Damaged

STRUCTURAL ASSESSMENT

Structure Type: Residential Houses and Infrastructure. The affected settlement contains residential structures and associated infrastructure located within a steep mountainous drainage environment, making them vulnerable to rapid flood flows and debris impact.

Cause: Heavy Rainfall triggered the flashflood and Affected Structural Integrity. Intense rainfall generated a sudden flash flood, producing high-velocity runoff and debris movement that inundated the settlement and adversely affected the structural integrity of houses and infrastructure.

TERRAIN & HAZARDS

Topography: Steep Mountainous Terrain

Main Adjacent Drainage: Seasonal Mountain Stream.

Prominent Hazards: Flash floods, Landslide, Rockfall, Slope Failure, Debris

Flow, Earthquake, Soil Erosion. The steep mountainous terrain and seasonal stream provide confined pathways for rapidly concentrated runoff. Landslides, rockfall, debris flow and erosion can compound flood impacts during intense rainfall.

RECOMMENDATION

Elevated Houses for flood protection. Raise vulnerable residential structures above expected flood levels and maintain safe drainage corridors to reduce direct inundation and improve resilience against future flash-flood events.



4. Major Causes of Infrastructural Failures

This section presents the principal engineering causes of infrastructural failures identified during the post-Monsoon 2026 Damage Assessment, covering residential and communication infrastructure. The assessment indicates that roof and wall collapse were the predominant modes of residential structural damage during Monsoon 2026. These failures were primarily associated with prolonged and intense rainfall, waterlogging, inadequate drainage, weak foundations, foundation soil erosion, poor construction practices, and the use

of substandard materials. The combined effects of these factors frequently resulted in progressive structural deterioration, partial collapse, and, in severe cases, complete failure of residential structures.

4.1 Residential Infrastructure

The post-monsoon damage assessment revealed that a considerable proportion of residential infrastructure failures during Monsoon 2026 resulted from structural deficiencies, inappropriate site selection, and poor construction practices. These failures were further aggravated by sustained rainfall, flash flooding, and subsequent waterlogging in vulnerable areas. The following analysis identifies the major engineering and planning shortcomings that contributed to widespread housing damages across multiple districts.

4.1.1 Poor Site Selection

A significant number of residential structures were found to be located in flood-prone zones, particularly along riverbeds, nullahs, and low-lying depressions with inadequate natural drainage. Settlements established in these areas were directly exposed to surface runoff and prolonged inundation during peak monsoon activity. This pattern of unregulated development demonstrates the absence of comprehensive land-use planning and enforcement of zoning regulations at the local level. The high-water table and poor drainage characteristics of these areas led to persistent waterlogging, which severely compromised the load-bearing capacity of foundation soils, eventually resulting in partial or complete structural failures.



Figure 9: Residential Settlements Located in Flood Prone Areas

4.1.2 Inadequate Foundation Design

Field investigations indicated that a majority of damaged houses employed shallow foundation systems constructed without consideration of site-specific soil conditions. The lack of geotechnical assessment or engineering supervision led to the use of weak and moisture-sensitive soil strata as bearing layers. Under prolonged saturation, these layers experienced significant loss of shear strength, triggering settlement, tilting, or cracking of superstructures. The absence of proper foundation reinforcement and inadequate footing depth, particularly in single-storey masonry dwellings, amplified vulnerability during sustained monsoon events.



Figure 10: Flood Affecting Residential Structures (Inadequate Foundation Design)

4.1.3 Foundation Soil Erosion

Prolonged floodwater exposure and unlined drainage channels caused progressive scouring and erosion of foundation soils. Houses situated near watercourses or along eroded embankments were especially prone to foundation soil erosion, where the removal of subsoil beneath the structure led to partial collapse. This phenomenon was prevalent in both urban fringe settlements and rural communities where drainage systems remain underdeveloped. Such erosion not only undermined the stability of the foundations but also induced tilting and separation of structural elements, rendering the buildings unsafe for habitation even after floodwaters receded.



Figure 11: Foundation soil erosion and scouring causing structural instability during monsoon flooding.

4.1.4 Blocked Drainage Systems

Inadequate surface and sub-surface drainage infrastructure emerged as another major cause of structural failure. Blocked or undersized drains, combined with poor site grading, resulted in the accumulation of standing water around building perimeters. Continuous waterlogging accelerated the degradation of foundations, facilitated seepage through walls, and weakened structural joints. The problem was further intensified by debris accumulation, lack of maintenance, and unplanned urban extensions that obstructed natural water paths. The assessment emphasizes that ensuring effective stormwater drainage systems at both community and household levels is critical to reducing future damage potential.



Figure 12: Blocked drainage causing severe urban waterlogging during monsoon rainfall.

4.1.5 Ground Movement and Differential Settlement

Several affected areas experienced significant ground movement due to saturation-induced slope instability, particularly in hilly and mountainous terrain. This movement often led to horizontal displacement and settlement of residential structures. Differential settlement, caused by uneven soil consolidation beneath foundations, resulted in visible cracking, tilting, and in some cases, partial collapse of houses. These issues underline the necessity of incorporating geotechnical studies and slope-stability assessments into future construction planning.



Figure 13: Ground movement and differential settlement causing severe cracking, tilting, and partial collapse of a hillside residential structure.

4.1.6 Substandard Construction Materials

A recurring theme in the field observations was the widespread use of low-quality, non-engineered materials. Many rural and peri-urban houses were constructed using unreinforced brick masonry, mud mortar, or loosely compacted earthen blocks. Such materials lack the tensile strength and water resistance required to endure prolonged exposure to moisture and hydraulic pressure. As a result, structural elements deteriorated rapidly when subjected to sustained rainfall and flooding. Cracking, spalling, and joint failures were commonly observed, rendering structures non-repairable in many cases. The absence of standardized building codes, limited technical oversight, and cost-driven shortcuts further exacerbated this condition.



Figure 14: Flood-damaged house constructed with substandard masonry materials, showing severe wall deterioration and fully collapse.

4.1.7 Lack of Proper Drainage

The absence of functional storm water drainage systems around residential settlements was a primary factor contributing to building damage. Without adequate channels for runoff, rainwater accumulated around structures, resulting in ponding and hydrostatic pressure against walls. Continuous seepage into foundations weakened building bases and caused cracking in structural elements.



Figure 15: Prolonged waterlogging around structures due to inadequate stormwater drainage during monsoon flooding.

4.1.8 Soil Settlement

Sustained rainfall led to high soil saturation, significantly reducing the ground's bearing capacity. The softened subsoil beneath foundations caused differential settlement, leading to wall cracking and in some cases partial collapse of structures. Houses built on soft alluvial soils or un-engineered fill were especially prone to such settlement-related failures during the monsoon period.



Figure 16: Soil settlement causing foundation displacement, severe wall cracking, and partial structural collapse during monsoon flooding.

4.1.9 Encroachments on Natural Waterways

Unregulated construction along natural drainage paths and floodplains exacerbated flood impacts. These encroachments obstructed natural water flow, creating backflow and concentrated hydraulic pressure against residential structures. The diversion of runoff into populated areas intensified erosion and flooding, leading to greater structural damage and foundation instability.



Figure 17: Residential damage intensified by encroachment on natural waterways

4.1.10 Inadequate Drainage Planning

Improper drainage planning, including insufficient slope design and lack of runoff management channels, allowed storm water to stagnate near building foundations. The resulting prolonged exposure to moisture caused wall seepage, material deterioration, and weakening of substructures. Many settlements lacked coordinated municipal drainage layouts, further amplifying local flooding effects.



Figure 18: Inadequate drainage planning causing prolonged waterlogging around residential structures during monsoon rainfall.

4.1.11 Foundation Failure and Structural Cracking

The combined influence of poor drainage, soil instability, and waterlogging triggered widespread foundation failures. Structural inspections revealed prominent wall cracks, floor settlement, and in some instances, complete structural failure due to compromised load-bearing capacity. Areas affected by prolonged submersion or recurring seepage showed accelerated structural degradation.



Figure 19: Foundation failure and severe structural cracking caused by prolonged waterlogging and soil instability.

4.2 Communication Infrastructure

The Monsoon 2026 events exposed significant vulnerabilities in Pakistan's communication infrastructure, particularly in road networks, culverts, causeways, and bridges. Multiple structural failures were recorded across various provinces, primarily resulting from hydrological stresses, design inadequacies, and insufficient maintenance of drainage systems. The observed damages were not isolated but reflected systemic weaknesses in design standards, river training works, and slope protection measures.

4.2.1 Design and Structural Deficiencies

A number of bridge and culvert failures were traced back to design limitations. In several instances, structures were unable to withstand high transverse and torsional stresses induced by peak monsoon flows. The lack of consideration for combined load conditions—bending, shear, and bearing—led to premature distress in superstructures and girders. The inadequacy of structural redundancy and poor detailing further exacerbated vulnerability during prolonged submersion and high-velocity flow conditions.



Figure 20: Bridge failure and structural distress under high-velocity flood flows.

4.2.2 Poor Drainage and Undersized Structures

In numerous sites, undersized drainage structures such as culverts and causeways were found insufficient to accommodate peak flood discharges. This led to overtopping, structural choking, and the redirection of floodwaters onto adjacent embankments and road surfaces. Blocked drainage channels and silted waterways compounded the issue, causing prolonged inundation and accelerated deterioration of pavement and subgrade layers. The lack of routine inspection and debris clearance was a recurring deficiency.



Figure 21: Undersized and debris-choked culvert causing overtopping, road inundation, and embankment erosion

4.2.3 Slope Instability and Poor Site Conditions

In mountainous and hilly regions, slope instability emerged as a major cause of road and bridge failures. Roads constructed on steep embankments without protective measures—such as retaining walls, gabion works, or stone pitching—were prone to washouts and landslides during heavy rainfall. The combination of weak geological formations and uncontrolled runoff significantly increased the frequency of embankment failures, cutting off critical communication links during the monsoon period.



Figure 22: Slope instability causing road embankment failure and landslide damage during heavy monsoon rainfall.

4.2.4 Sedimentation and Debris Load

Heavy siltation, boulders, and tree debris transported by monsoon floods caused extensive clogging of culverts and drainage channels. This sediment and debris accumulation obstructed water flow, increasing hydrostatic pressure on structures and leading to the collapse of culvert wing walls and damage to bridge piers. In several districts, the blockage of hydraulic channels diverted floodwater onto road surfaces, worsening erosion and transport disruption.



Figure 23: Sediment and debris accumulation clogging culvert openings and obstructing floodwater flow.

4.2.5 Soil Erosion and Landslide Impacts

Persistent rainfall triggered soil erosion and slope failures, particularly along unprotected embankments and mountainous road sections. Erosion undermined bridge abutments and road foundations, while landslide debris buried road corridors and drainage systems. These erosive processes not only disrupted connectivity but also increased the maintenance burden and risk of future structural instability.



Figure 24: Soil erosion and landslide debris causing road embankment failure and disrupting connectivity during monsoon rainfall.

4.2.6 Aging Infrastructure and Design Deficiencies

A substantial portion of Pakistan's rural bridges and road networks remain outdated and under-designed for current hydrological and hydraulic loads. Many structures were constructed decades ago without accounting for the increased rainfall intensity and sediment load patterns now being experienced. The lack of modern design standards, reinforced materials, and hydrological modeling has rendered these assets particularly vulnerable during extreme weather events.



Figure 25: Aging bridge infrastructure showing severe deterioration and vulnerability to monsoon flood flows.

4.2.7 Unregulated Sand and Gravel Mining

Uncontrolled extraction of sand and gravel from riverbeds near bridge foundations has exacerbated scouring and weakened structural supports. This practice has lowered riverbed levels, exposed foundations, and accelerated the rate of erosion around critical infrastructure elements. The degradation of natural river channels due to mining has further intensified the vulnerability of bridges and culverts to flood-induced failure.



Figure 26: Bridge foundation Vulnerability due to unregulated sand & gravel mining

5. Key Recommendations for Resilient Infrastructure

This section sets out region/province-wise recommendations for resilient reconstruction and retrofitting of communication and residential infrastructure, derived from the failure mechanisms identified in section 4. Recommendations are organized under Punjab, Khyber Pakhtunkhwa, Azad Jammu & Kashmir/Gilgit-Baltistan, Sindh and Balochistan, reflecting the differing terrain, hydrology and construction typologies of each region. Interventions should be applied on a site-specific design basis, informed by local hydraulic, geotechnical and terrain conditions, as part of a risk-informed infrastructure planning approach.

5.1 Punjab

Infrastructure damage in Punjab is characterized principally by water ingress, waterlogging and slope/retaining-structure instability affecting both housing and road/drainage networks in flood-prone and canal-command areas. Recommended interventions focus on waterproofing, controlled drainage and retrofit of retaining structures, together with a shift toward pre-engineered construction to reduce site-specific quality variability.

5.1.1 Communication Infrastructure

Recurrent scouring and slope instability along road embankments and drainage corridors in Punjab call for reinforced slope-retention and storm water-management measures capable of handling concentrated monsoon runoff.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Slope instability and erosion at embankments and cut slopes	Ground anchor walls and soil nailing to stabilize slopes and retain in-situ soil mass	Restores slope stability and reduces the risk of progressive erosion-induced failure
Loss of lateral support at road and structure edges	Retaining walls at vulnerable embankment and approach sections	Provides positive lateral confinement, preventing edge erosion and settlement
Surface water ponding and drainage overload	Upgraded stormwater drainage systems sized for monsoon-intensity runoff	Reduces water retention time and associated saturation-driven failures



Figure 27: Ground anchor wall installation providing lateral slope stabilization.



Figure 28: Retaining wall construction protecting an embankment or road edge from erosion.

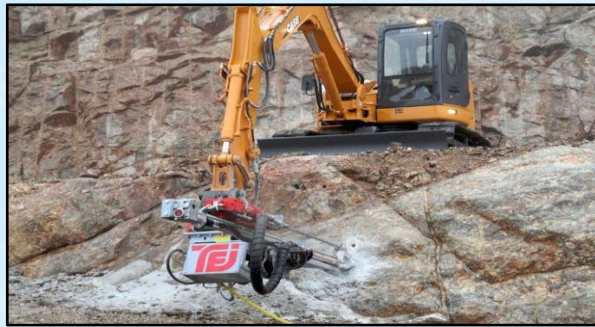


Figure 29: Soil nailing application for in-situ slope reinforcement.

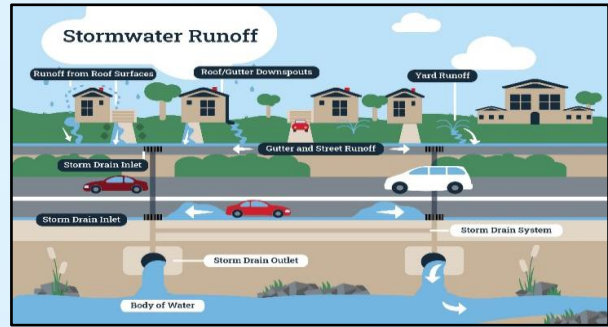


Figure 30: Stormwater drainage infrastructure designed to convey concentrated monsoon runoff.

5.1.2 Residential Infrastructure

Residential structural damage in Punjab is closely associated with water ingress through building envelopes and foundations, and with quality inconsistency in informally constructed masonry. A shift toward waterproofed, factory-controlled construction is recommended.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Water ingress through foundations, plinths and walls	Cementitious waterproofing of foundations, plinths and below-grade masonry	Reduces moisture ingress, limiting saturation-driven settlement and material degradation
Water penetration through roofing and exposed surfaces	Bituminous coating on roofs and exposed masonry surfaces	Provides a durable waterproof membrane resistant to prolonged monsoon exposure
Variable construction quality and settlement vulnerability	Pre-cast structural components manufactured under controlled conditions	Improves dimensional accuracy and material quality, reducing settlement-related defects
Prolonged reconstruction timelines and quality control limitations	Pre-fabricated structural systems for rapid, standardized reconstruction	Enables faster, quality-assured rebuilding with reduced exposure to on-site workmanship variability



Figure 31: Cementitious waterproofing application to a foundation or below-grade masonry surface.



Figure 32: Bituminous coating application providing a waterproof membrane on exposed surfaces.

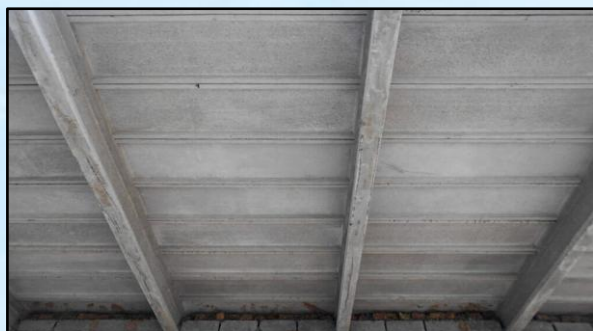


Figure 33: Pre-cast structural component used to improve construction quality and settlement resistance.



Figure 34: Pre-fabricated structural system enabling standardized, rapid residential reconstruction.

5.2 Khyber Pakhtunkhwa (KPK)

The hilly and mountainous terrain of Khyber Pakhtunkhwa exposes both communication and residential infrastructure to slope instability, debris flow and drainage-obstruction hazards in addition to conventional water-ingress damage. Recommendations therefore emphasize slope stabilization and structural reinforcement alongside drainage maintenance and moisture protection.

5.2.1 Communication Infrastructure

Slope-related hazards dominate infrastructure vulnerability in KPK, requiring a combination of erosion protection, structural bracing and surface stabilization measures suited to steep terrain.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Slope and embankment instability on steep terrain	Ground anchoring to secure unstable slope faces and structural elements	Provides deep, positive restraint against slope displacement
Channel bank and embankment erosion under high-velocity flow	Riprap protection at exposed banks, embankments and structure foundations	Dissipates flow energy and resists erosive scour at vulnerable interfaces
Structural instability of exposed or damaged elements	Bracing of vulnerable structural components	Restores lateral stability and load-carrying capacity pending permanent repair
Loss of surface integrity on slopes and cut faces	Shotcreting to stabilize and protect exposed slope and structural surfaces	Provides an erosion-resistant structural surface that limits further material loss



Figure 35: Ground anchoring system used to stabilize an unstable slope or structural element



Figure 36: Riprap protection installed to resist erosion at an embankment or channel bank.



Figure 37: Structural bracing providing lateral stability to a vulnerable element.



Figure 38: Shotcreting application stabilizing an exposed slope or structural surface.

5.2.2 Residential Infrastructure

Residential resilience in KPK depends on reinforced framing, effective roof drainage and prompt repair of moisture-related cracking, alongside maintenance of local drainage to prevent water accumulation around structures.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Lack of lateral load resistance in masonry construction	Band beams and reinforced columns integrated into masonry structures	Improves structural integrity and resistance to differential movement
Water accumulation around structures due to blocked drains	Regular unclogging and maintenance of local surface drains	Restores drainage capacity, reducing prolonged saturation of foundations
Water penetration through flat or poorly draining roofs	Sloped or pitched roofing to facilitate rapid rainwater shedding	Reduces water ponding and associated roof and wall moisture ingress
Cracking from settlement or moisture-related material distress	Epoxy injection repair of structural cracks	Restores structural continuity and limits further moisture ingress through cracked sections



Figure 39: Band beam and column reinforcement integrated into residential masonry construction.



Figure 40: Maintenance of a local surface drain to prevent water accumulation near structures.



Figure 41: Sloped/pitched roofing designed to shed monsoon rainfall efficiently.



Figure 42: Epoxy injection repair of a structural crack in masonry.

5.3 Azad Jammu & Kashmir / Gilgit-Baltistan (AJ&K/GB)

The mountainous and seismically active terrain of AJ&K/GB, combined with steep slopes and heavy monsoon and snowmelt-influenced runoff, makes slope stabilization and lightweight, resilient construction typologies particularly important. Recommendations draw on traditional and modern resilient construction practices suited to the region's terrain.

5.3.1 Communication Infrastructure

Slope stabilization measures adapted to steep, erosion-prone terrain are prioritized for communication infrastructure in AJ&K/GB, alongside structural reinforcement of exposed elements.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Loss of exposed surface integrity on slopes and structures	Shotcreting to stabilize exposed slope and structural surfaces	Provides a durable, erosion-resistant protective surface
Bank and embankment erosion under high-velocity flow	Riprap protection at vulnerable banks and embankments	Resists erosive scour and stabilizes the toe of slopes and embankments
Structural instability under seismic and hydrological loading	Structural bracing of vulnerable elements	Improves lateral stability pending permanent retrofit or reconstruction
Slope erosion on exposed, vegetation-denuded terrain	Slope vegetation and bio-engineering measures to stabilize exposed ground	Reduces surface runoff velocity and reinforces soil through root structure



Figure 43: Shotcreting application on an exposed slope or structural surface for erosion protection.



Figure 44: Riprap protection at a vulnerable embankment or channel bank.



Figure 45: Structural bracing applied to a vulnerable communication infrastructure element.



Figure 46: Slope vegetation used to stabilize exposed terrain and reduce surface erosion.

5.3.2 Residential Infrastructure

Given the seismic and slope-hazard context of AJ&K/GB, resilient residential construction favours lightweight, ductile building typologies with efficient roof drainage, complemented by pre-fabricated systems for rapid, standardized rebuilding.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Structural vulnerability of unreinforced masonry on unstable terrain	Timber-reinforced house construction combining ductility with local material availability	Improves seismic and ground-movement resilience through a lightweight, ductile structural system
Water penetration through inadequate roof profiles	Sloped roof construction to promote rapid rainwater and snow shedding	Reduces water ponding and associated structural moisture ingress
Extended reconstruction timelines and quality variability	Pre-fabricated house systems for standardized, rapid reconstruction	Enables faster, quality-controlled rebuilding suited to remote terrain
Roof-level water retention and structural loading	Pitched roof profiles designed for efficient drainage	Minimizes accumulated roof loading and associated water ingress risk



Figure 47: Timber-reinforced house construction providing a lightweight, resilient structural system.



Figure 48: Pre-fabricated house system enabling rapid, standardized residential reconstruction.



Figure 49: Sloped roof construction designed for efficient rainwater and snow shedding.



Figure 50: Pitched roof profile minimizing water retention at the roof level.

5.4 Sindh

Infrastructure vulnerability in Sindh is closely linked to flat terrain, limited natural drainage gradient, and reliance on traditional adobe and unreinforced masonry construction. Recommendations emphasize improved drainage conveyance, structural reinforcement of housing, and hydraulic structures capable of managing sustained high-volume flow.

5.4.1 Communication Infrastructure

Given the flat topography and high flood-plain exposure typical of Sindh, communication infrastructure recommendations focus on hydraulic conveyance structures and erosion protection at drainage crossings.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Bank and structure erosion under sustained flood flow	Riprap protection at vulnerable banks, embankments and structure foundations	Provides erosion resistance under prolonged high-volume flow conditions
Obstructed cross-drainage at road and canal crossings	Culverts sized and maintained for adequate hydraulic conveyance	Restores cross-drainage capacity, reducing upstream ponding and overtopping
Insufficient conveyance across major flow paths and canal networks	Aqueduct structures to convey water across incompatible grade intersections	Maintains continuous hydraulic conveyance while preserving road/canal alignment integrity



Figure 51: Riprap protection installed at a bank or structure foundation exposed to sustained flood flow.



Figure 52: Culvert structure providing cross-drainage conveyance beneath a transport corridor.



Figure 53: Aqueduct structure maintaining hydraulic conveyance across an intersecting alignment.



Figure 54: Aqueduct structure illustrating conveyance design across a flow path.

5.4.2 Residential Infrastructure

Residential resilience in Sindh depends substantially on improving the drainage and structural performance of traditional housing typologies, particularly adobe and unreinforced masonry construction that is highly susceptible to prolonged water exposure.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Water accumulation around structures on flat, poorly graded sites	Adequate slope and drainage provision around residential plots	Directs runoff away from foundations, reducing saturation-driven distress
Structural vulnerability of unreinforced masonry housing	Adequate reinforcement of housing structures	Improves load-carrying capacity and resistance to settlement-induced cracking
High susceptibility of traditional adobe construction to water damage	Improved adobe structures incorporating stabilized materials and moisture protection	Retains traditional construction character while improving water resistance and durability



Figure 55: Site grading and drainage provision directing runoff away from a residential structure.



Figure 56: Reinforcement measures applied to improve residential structural resilience.



Figure 57: Reinforcement of a housing structure to improve load-carrying capacity.



Figure 58: Improved adobe construction incorporating enhanced moisture protection

5.5 Balochistan

Infrastructure in Balochistan is exposed to flash-flood conditions across arid and semi-arid terrain, where infrequent but high-intensity rainfall generates rapid runoff concentration. Recommendations accordingly emphasize elevated and waterproofed housing construction together with hydraulic structures and pier protection designed for flash-flood loading.

5.5.1 Communication Infrastructure

Flash-flood conditions in Balochistan require hydraulic structures and scour-protection measures capable of accommodating rapid, high-intensity discharge with minimal warning time.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Pier and foundation scour under flash-flood discharge	Concrete block protection placed around pier foundations	Provides physical scour protection, maintaining pier embedment under high-velocity flow
Insufficient conveyance across intersecting flow paths	Aqueduct structures to maintain hydraulic conveyance across incompatible alignments	Preserves continuous drainage conveyance while protecting the transport corridor
Concentrated runoff exceeding conventional drain capacity	Trapezoidal drain channels sized for flash-flood discharge	Provides efficient hydraulic conveyance with stable, erosion-resistant channel geometry



Figure 59: Concrete block protection installed around a bridge pier foundation.



Figure 60: Aqueduct structure maintaining conveyance across an intersecting flow path.



Figure 61: Hydraulic conveyance structure designed for flash-flood discharge conditions.



Figure 62: Trapezoidal drain channel providing efficient conveyance of concentrated runoff.

5.5.2 Residential Infrastructure

Residential construction recommendations for Balochistan focus on elevating structures above flash-flood inundation levels and improving waterproofing and roofing performance under intense but infrequent rainfall.

Vulnerability / Failure	Recommended Intervention	Resilience Benefit
Structural exposure to flash-flood inundation	Elevated housing construction above anticipated flood levels	Reduces direct exposure of the structure to flash-flood inundation
Water penetration through roofing under intense rainfall	CGI (corrugated galvanized iron) sheet roofing for rapid water shedding	Provides a lightweight, water-resistant roofing solution suited to intense rainfall events
Water ingress through foundations and exposed masonry	Cement-based waterproofing of foundations and exposed surfaces	Reduces moisture ingress and associated foundation and wall deterioration
Moisture-related degradation of roofing and exposed surfaces	Asbestos-cement coating/sheeting as a durable, low-maintenance surface protection	Provides a durable protective surface resistant to weathering, subject to appropriate handling and safety precautions



Figure 63: Elevated housing construction reducing exposure to flash-flood inundation.



Figure 64: CGI sheet roofing providing rapid rainwater shedding.



Figure 65: Cement-based waterproofing application on a residential structure.

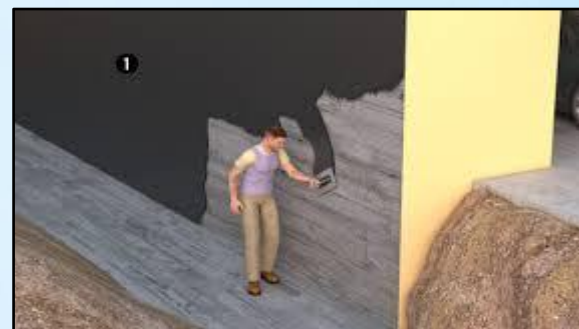


Figure 66: Durable surface coating applied for weathering resistance.

6. Conclusion

The Monsoon 2026 season in Pakistan once again highlighted the country's high exposure to hydro-meteorological hazards and the resulting vulnerability of its built environment. The nationwide post-monsoon assessment conducted by the National Disaster Management Authority (NDMA) provides a clear and data-driven understanding of the magnitude, distribution, and nature of infrastructure damages across all provinces and regions. This report not only serves as an evaluative document but also as a critical policy instrument for guiding future planning, mitigation, and reconstruction strategies.

The assessment reveals that while the intensity of the monsoon events varied geographically, the underlying causes of infrastructure failure were largely systemic—stemming from inadequate design standards, poor maintenance regimes, non-engineered construction practices, and unregulated land use in hazard-prone zones. The widespread damage to roads, bridges, and housing structures across Khyber Pakhtunkhwa, Gilgit-Baltistan, Azad Jammu & Kashmir, Punjab, Sindh, and Balochistan underscores the urgent need to integrate resilience thinking into every stage of infrastructure development.

The analysis further emphasizes that climate change is intensifying the scale and frequency of extreme rainfall events, requiring immediate adaptation in both design and policy. Hydrological and geotechnical assessments must become mandatory components of project feasibility studies, particularly for public infrastructure in high-risk zones. Moreover, the enforcement of provincial and national building codes must be strengthened to ensure that residential and public structures adhere to minimum safety standards. Strengthening local governance, promoting community awareness, and building technical capacity among local engineers and masons will play a decisive role in reducing recurrent losses.



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https://ndma.gov.pk/infra_by_category/3