Fundamental study on accumulation of pore air pressure in geomaterials due to excessive supply of water

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The purpose of this study is to observe and explain the behavior of pore air pressure in geomaterials due to excessive supply of water. The pore air pressure has a significant effect under the conditions that there is oversupplied water from heavy rain or the rise of the river water level. In order to reveal the system of infiltration considering the pore air pressure, we did simple experiments of one-dimensional vertical infiltration. As a result, we deduced that flooding happens on the surface of a specimen when pore air pressure reached the value caused by capillary action. Moreover, besides water pressure head and capillary pressure, weights of saturated portion contribute increasing pore air pressure. In addition, we recognized the remarkable difference between Toyoura-sand and Kanto-roam. Then the state of dry or low gaseous phase ratio are likely to generate higher maximum pore air pressure.

Keywords: geomaterial, excessive supply of water, pore air pressure

Issues on Hazard Information during 2015 Kanto-Tohoku Heavy Rain Disaster from the View Point of a Health and Medical Responder

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The author will talk about the outline of his activities on health and medical assistance in Joso and Tsukuba city during Kanto-Tohoku heavy rain disaster in 2015, and also provide information on the workers’ response of Joso health center to the emergency warnings such as the evacuation alert with the intention of enhancing discussions for better countermeasures. National Institute of Public Health (NIPH), in which the author works, is a national agency under the Ministry of Health, Labour and Welfare for conducting research that yields evidence-base of public health policies as well as providing training courses for health center workers. The institute is now discussing the curriculum of health emergency management to improve countermeasures on public health during large-scale disasters. The author also takes part in “Enhancement of Societal Resiliency against Natural Disasters”, one of the topics of “Cross-ministerial Strategic Innovation Promotion (SIP) Program” of Council for Science, Technology and Innovation and conduct research on the information sharing among multiple agencies during disasters. The author visited Joso city and Tsukuba health center during Kanto-Tohoku heavy rain disaster in 2015 to reveal issues to be tackled in SIP program. The author will focus on the initial response of health center workers revealed by the interview to the director of the health center in his presentation.

Keywords: Kinu river, Joso health center, Information sharing

Resourcing a disaster response map for the 2015 heavy rain in Joso city

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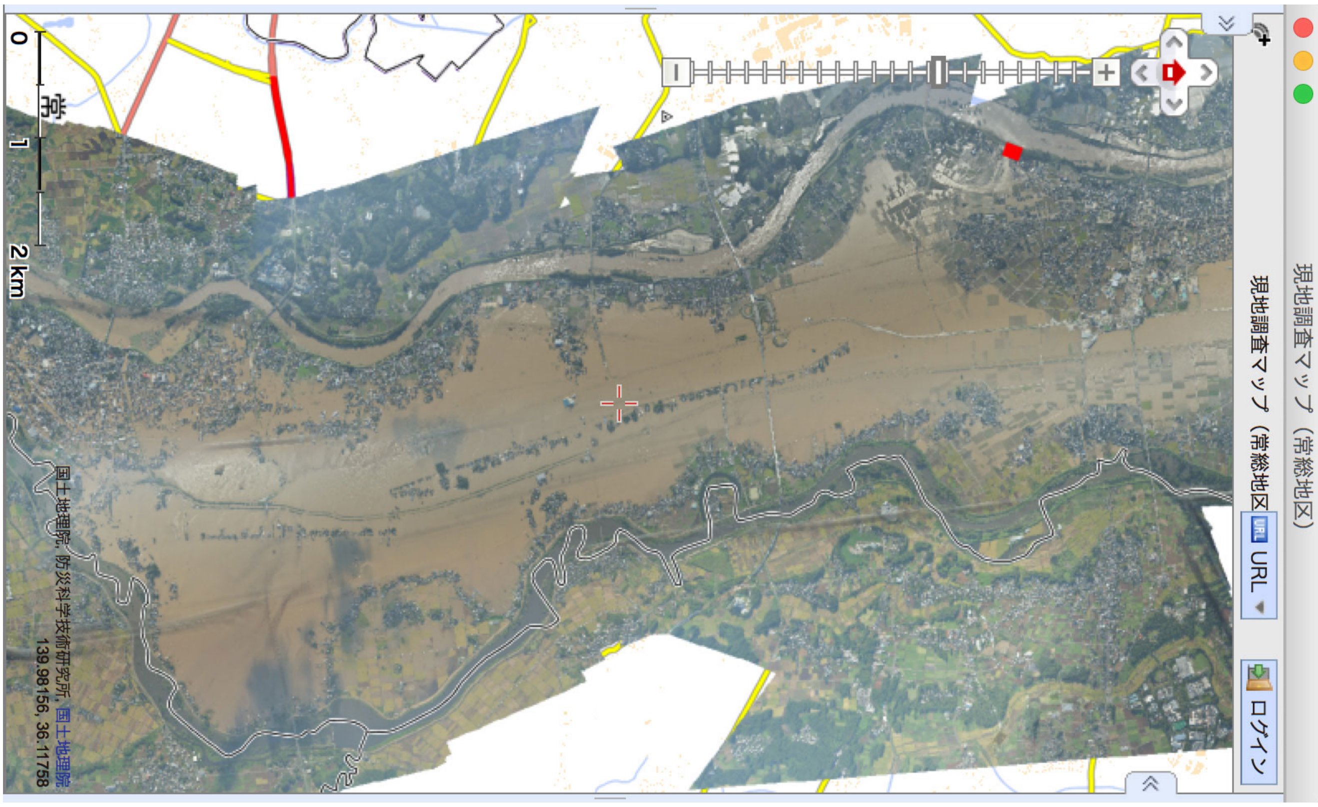
1. Motivation
From September 9th to 11th 2015, an exceptionally heavy rain storm caused the occurrence of the overflow of the Kinugawa River and landslides in a wide range of areas in the Kanto and Tohoku districts. One bank of Kinugawa River collapsed causing wide-spread flood damage in and around Joso city in the Ibaraki Prefecture of Japan. Homes were destroyed and washed away leaving many residents’ property completely underwater. Gaining a quick understanding of the disaster’s magnitude was critical for effective search and rescue (SAR) response, and decision-making so as to carry out local government offices’ rehabilitation measures to rescue the residents of the submerged town.
2. Approach
In this case, the disaster area was as vast as 100 square kilometers as documented by aerial photography using a Nikon D810 from a manned helicopter, rather than from any unmanned aerial vehicles. The flight level was 1,200 m in altitude and course and speed were set to create a 75% overlap in the photography.
3. Results
About 600 oblique photographs were taken from flight level 1,200 m between 15:30-16:30 hours on September 11, 2015 to create a digital orthoimage of about 100 square kilometers of the flood region. In addition to the aerial photographs, ground survey data and the orthoimage were made available to the public within 12 hours on the crisis response website of the NIED. These resources have been provided under the auspices of the Creative Commons license “CC-BY 4.0 international.” Subsequently, the map that overlaid the housing map of Zenrin, Inc. was created for September 15, 2015, and the disaster countermeasures office was provided with it. In addition, a missing person's distribution was estimated from the map and a professional team of private SAR and a NPO Japan rescue dog association provided search assistance on the same day.
4. Considerations
First, although a lot of information has been released by each organization, there are some problems regarding copyright, data size, and reliability. Effective use of such information in a post disaster situation is difficult. In this case, the information was provided as open data, allowing users access to the information without the difficulty of making an application for permission. The data was used by the disaster countermeasures office, the volunteer center, and the university investigating the disaster. Second, the high definition photographic map of a disaster site makes it much easier to grasp the full impact of a disaster situation. However, when the user is not familiar with how to interpret the information provided by such maps, it is difficult to utilize these map resources effectively. Consequently, it is necessary to support local public entities by also providing directions for how to understand the map information. Finally, although photography was performed from a manned helicopter, 14 or more rescue/reporting helicopters surveyed the area for only 30 minutes. Though there may be an expectation that unmanned aerial vehicles may be deployed for information gathering following a disaster, it is difficult to operate such aerial vehicles safely in airspace where manned aerial vehicles are operational simultaneously. Excellent communication and cooperation are necessary during such operations to protect the safety and integrity of both.

Keywords: the 2015 heavy rain, disaster response map, Joso city, SfM-MVS (Structure from Motion and Multi-view Stereo)



Distribution of floodwater depth and damages of road structures in Joso City, Ibaraki Prefecture, caused by the Kanto-Tohoku torrential rain in September 2015

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The torrential rain on September 2015 in Kanto-Tohoku regions caused the collapse and overflow of embankment along the Kinu River, and floodwaters inundated the widespread area of Joso City, Ibaraki Prefecture. Flood inundation depth in Joso City was estimated based on the height of flood marks on buildings and houses. Field reconnaissance in inundation area was conducted to measure the height of flood marks by using leveling rod. The height of flood marks were obtained at 100 sites in the inundated area. The height of flood marks in the inundated area were less than 3 m, and most of these obtained values were similar or below the values that were presented on the flood hazard map of Joso City. In the inundated area, severe damages of road embankments and structures were observed in the back marsh area (paddy fields) between the natural levees along the Kinu River and Kokai River.

Keywords: Kanto-Tohoku torrential rain in September 2015, Kinu River, floodwater depth, hazard map, damage of road structure, Joso City

Inundation of the eastern part of Joso city, Ibarki prefecture caused by heavy rainfall disaster in Kanto and Tohoku area

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Heavy rainfall of September 2015 in Kanto and Tohoku area caused severe flood in the eastern part of Joso city, Ibaraki prefecture. Kinu River water started to flow over banks at around 6 am at Wakamiyado district and collapse of Kinu River bank at around 12:50 PM at Kamimisaka district on 10th September resulted in extensive inundation of Ishige area located on natural levees. Then, flood moved southward along the Hakkenbori River and inundation of Mitsukaido area started at the night of 10th September to widely inundate the area nearby at 1 pm on 11th September. The maximum inundation depth confirmed by authors from the flood marks remained on the building walls are less than 1.0 m on natural levees, but it reaches 1.5 m at the maximum in core portion of the flood flow identified by flood deposits. In the floodplain, deeper inundation occurred than natural levees, and more than 2.5 m inundation was found at Okishinden and Jyukkamachi Okishinden district. Deeper inundation was observed in the southern part of the floodplain because higher natural levee surfaces at Mitsukaido area probably prevented to drain water smoothly. Although inundation of Ishige area was comparatively short and ended by the morning of 11th September, inundation of Mitsukaido area prolonged and continued until at least the morning of 13th September in the area north of Shinhakenbori River, and until 16th along the Hekenbori River. Restoration of destroyed river bank and roads was prioritized, but cleanings of flood sediments and debris take long time and still households and offices need a certain time to be fully recovered. Also, some important facilities such as hospital and school experienced inundation of more than 1.5 m. Therefore, we need to record the flood impacts and evaluate them appropriately for the formulation of flood disaster risk reduction strategies in the area.

Keywords: flood, Joso city, Kinu River, inundation depth

The relative height map which visualized the slight topography of the flooding plains by aviation laser data

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In late years the damage caused by the flood of the small and medium size scale decreases as river improvement measures of the river advance. However, the development of the flooding plains along the river advances with this, and companies performing population and economic activities to settle down in without assuming a flood risk increase.The government works on making, publication of the hazard map and the maintenance of the caution refuge system continuously now. However, it is the event of the dike over there, and, for inhabitants, a company targeted for many staffs of local government and refuge, the flood is said to be it when hard to be readily arrested as a realistic risk since it is invisible. Particularly, the slight topography of the flooding plains that greatly influence distribution of the inundation depth at the time of a flood is very incomprehensible for a citizen, and understanding is difficult when I do not have a skill to be able to comprehend the special drawings such as figures of river improvement topography classification.In late years the maintenance of the highly precise numerical value topography model by the aviation laser measurement advanced and almost completed the maintenance of the numerical value topography model of the big river riverside. In addition, I came to be able to photograph a high-resolution aerial photo relatively easily. I visualize the slight topography such as the flooding plains, at the back damp ground which I match these techniques and use it, and influences the understanding of the flood risk along the river and the three-dimensional management of river facilities for a citizen and the administrative person in charge, and a technique to be actualized with a risk attracts attention.In the case of Kanto, Tohoku heavy rain, large-scale flood damage visualized the slight topography of flooding plains about Joso-City that occurred in September, 2015 and it was plain and, in this study, produced "a relative height map" to accuse experimentally.The topography which a human being usually sees is an irregularity in comparison with the neighborhood namely relative height, and the relative height is one of the elements which it is big, and influences the big things and small things of the inundation risk for at the time of floods again."The relative height map" sets a datum level to represent level ground of the river rear and makes the thing which I analyze the relative height with it and expressed with an appropriate color by letting irregularity information of the ground do an overlay. At this chance it was important that I let you display it at appropriate gradation and it was plain and was able to express the slight topography of flooding plains as a result of adjustment to emphasize a little slight topography of flooding plains. In addition, I was able to regard the slight topography of flooding plains as dike high School integrally by making "a relative height map" with the ground about the bank of a river separately, and fitting it.I compare it with overflow water, a rip point and the distribution of the depth of the inundation that "a relative height map" and Ministry of Land, Infrastructure and Transport and the research organization others which I made announce and am going to repeat improvement in future so that it is with "the relative height map" which can read a flood risk more precisely.

Keywords: flooding plains, microtopography, The relative height map, visualization, digital terrain model

Crevasse-splay deposits of the 2015 Kanto–Tohoku Torrential Rain Disaster in Kami-Misaka, Joso City, Ibaraki, Japan

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Introduction

The 2015 Kanto-Tohoku Torrential Rain (JMA, 2015) caused a severe flood disaster along the middle reaches of Kinugawa River. Rapid water level rise resulted in a dike break 200 m wide in Kami-Misaka district in Joso City. The KRDB (2015) reported that overbank flow had been recognized at 11:00 and dike break began at 12:50. In order to clarify distribution and sedimentological feature of "crevasse-splay deposits (Masuda, 1998)" in this flooding, we conducted small trench excavation survey in Kami-Misaka district.

Distribution of crevasse-splay deposits

Erosional landforms, including pools and crevasse channel were dug by flood stream near the dike break site, which have >1.6 m depth and <60 m width. From that point, crevasse-splay deposits were distributed westward to southward. At least three sandy lobes elongated downward were found. Thickness of crevasse-splay deposits was less than 10 cm in the range of 150 to 250 m off the dike except for behind scattered rubbles. Thick crevasse-splay deposits were found between 250 m and 700 m, which consisted of sandy lobes. We found that thickness reached the maximum (around 80 cm) at ~400 m off the dike and decreased gradually downward from there. Only muddy flood deposits were distributed in southern area from 700 m off the dike.

Sedimentary Facies

Crevasse-splay deposits were suggested to be divided into 3 units, Facies A to C in ascending order.

Facies A: This unit was inverse graded sandy deposits from silt or silty fine sand to fine sand. This covered directly artificial soils of paddy fields with sharp boundary. Some layers of plant debris such as paddy were found. The thickness reached 25 cm in NW part of the lobe and declined southward.

Facies B: This unit consisted of fine to medium sand showing normal grading. Lenticular thin medium sand layers were sometimes found. Upper part showed parallel lamination. Concentrated layers of plant debris and small rubbles were found. The thickness became the maximum, around 20 cm, in the center of transverse section and decreased toward both edges.

Facies C: This unit consisted of well-sorted fine to medium sand with parallel lamination. Upper part showed ripple lamination. Cross lamination developed at the marginal part of the lobe. Rounded to sub-rounded granules, ~3 cm in diameter, were found. The thickness increased southward.

Discussion

Facies A to C were suggested to coincide with sedimentary processes during the flood.

It is suggested that the Facies A deposited at the overbank stage. Inverse grading shows that velocity of overbank flow and/or coarser sediments supply increased. At the beginning of flood, washed load was supplied from river, and then coarser sediments were transported by high velocity flood current (Masuda and Iseya, 1985).

Graded beds indicate that the Facies B was deposited by sediment gravity flow or at decreasing stage of clastic materials supply. It is possible that the sediment gravity flow occur when dike was broken. Distribution pattern that this facies distribute on the downstream side of the erosion landforms supports this idea. While, temporal large supply from the river just after the dike break probably resulted in few sediment supply and fine suspended materials deposition.

Parallel lamination and granules suggest that the Facies C deposited at upper flow regime. Expansion of broken dike had accelerated flood current for a few hours (Tsuneda, 2015). This suggests that the Facies C deposited after the dike break event. Ripple lamination indicates declining of flood current.

Reference

JMA (2015) available in: http://www.jma.go.jp/jma/press/1509/18f/20150918_gouumeimei.pdf (published in Sep. 18, 2015).

KRDB (2015) available in: http://www.ktr.mlit.go.jp/ktr_content/content/000633805.pdf (published in Oct. 13, 2015)

Keywords: 2015 Kanto-Tohoku Torrential Rain Disaster, Crevasse-splay deposit, Joso City, Kinugawa River

Particle size analysis of natural levee deposit and flood sediment around the dike-broken site, Kinugawa River

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The flood on 10 Sep 2015 broke the dike in Kinugawa River, and the protected inland was covered with huge amount of flood sediment. The inland locates on natural levee, field survey revealed that natural levee deposit is finer than this flood sediment in particle size. I sampled both deposit and sediment, which were sieved and diveded at one-phi interval from -2 phi to less than 4 phi. As a result, it was found that fine sand of 4 phi notablly exists in natural levee deposit, but medium sand of 2-3 phi notablly exists in this flood sediments. This infers that contribution of scouring of natural levee is quite low for supplying this flood sediment. This study was supported by Promotion Grant of Special Study, Grant-in-aid Scientific Research (Grant number: 15H06923; Principal Researcher: Prof. Shigenobu Tanaka, Kyoto Univ).

Keywords: Flood, Natural levee, Sediment