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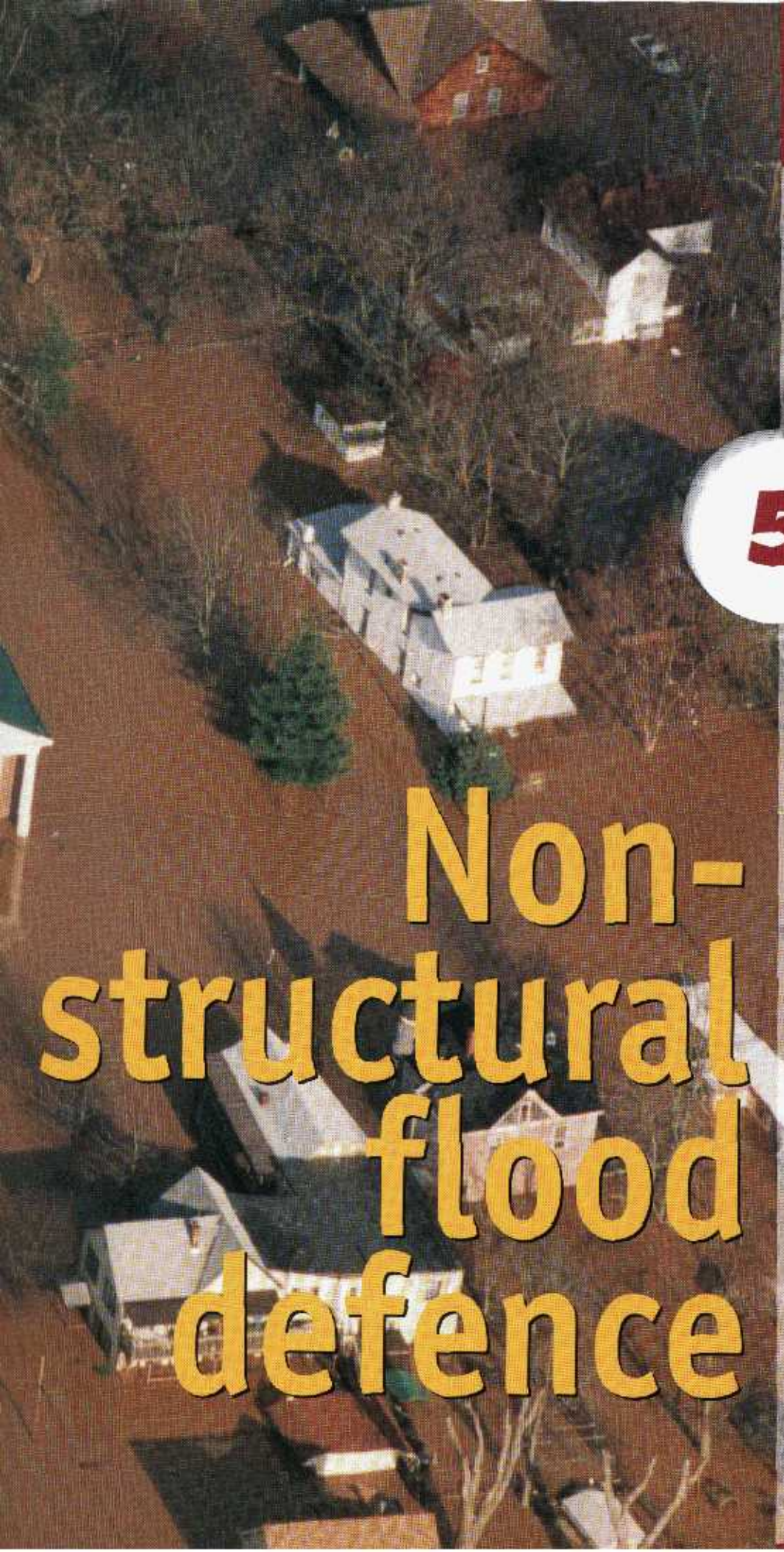
Non-structural flood defence



Floods in Wansley, Ohio.
Sipa Press. N. Lauron

Floods in Lisbon, November 1983.

The non-structural flood defence measures to be considered here include land-use planning and zoning to control the use of flood-prone areas, flood-proofing of existing structures, soil and water conservation to reduce flood flows and forecasting and warning systems. The aim of all these methods is to keep people and their property out of the way of floods. They are often portrayed as working with nature in contrast to the structural measures described in the previous chapter, but this is a false distinction. Any flood control system needs to use an appropriate mix of structural and non-structural measures. The two can and should complement each other.

Control of flood plain development

This is the most important of the non-structural measures for flood plain management. Flood plain maps (see chapter 3) indicate the areas that are subject to flooding and thus where development needs to be controlled if flood damage is to be reduced. A variety of methods is available for controlling development and the particular methods adopted will depend on the legal and administrative systems of the country. Usually, control will involve some form of land-use regulations. These need to be set in the appropriate legal context, depending on the planning system of the country. Experience shows that flood plain regulation is most successful when it is fully integrated within the land and development planning system at national or provincial level. Purely local regulation systems often fail because of legal or political challenges. Integration within the national or provincial planning system gives the flood plain regulation system additional legitimacy because the national system is familiar to citizens, embodies the necessary review and appeal procedures to ensure fairness and will promote uniform standards. On the other hand, integration within the national or provincial planning system also means that planners consider flood aspects when granting planning permission for new developments.

The regulations establish zones where particular types of development are prohibited. These zones must be based on an accurate flood plain map drawn to a specified design flood level so that the effect of the regulations is clear to all concerned. Flood plain regulation has been found to be a cost-effective method of minimizing flood damages associated with

future development, but it does not reduce the risk to existing flood plain developments. However, these existing developments can, over time, usually be brought into conformity with the regulations.

The regulations do not need to prohibit all development on the flood plain. There is a whole range of activities with different vulnerabilities to flooding that can be considered for the flood plain. These include agriculture, particularly the grazing of livestock that can be moved in times of flood, or crops that can be grown outside the flood season; recreational uses such as parks or playing-fields; wildlife reserves, including wetlands; and secondary transport routes and car parks. A feature of most of these possible flood plain uses is that they can be interrupted at flood times with only slight inconvenience. Other developments, that would suffer some loss if flooded, may have to be allowed on the flood plain in certain circumstances. On the other hand, there are facilities that should never be located in the flood plain because they will be needed in times of a flood emergency. These include hospitals, telephone exchanges, electricity sub-stations and emergency control centres. If the developments permitted on the flood plain require evacuation then some warning of future flooding is needed and a flood forecasting system as described below will be needed.

Care must be exercised in selecting the activities to be sited on the flood plain. For example, in a number of holiday areas camp-sites have been located on the flood plains of small rivers. The site is flat and thus suitable for tents and caravans and the proximity of the river adds to its attraction. Campers only occupy a camp-site temporarily and this would seem therefore to be a suitable use for the flood plain. In July 1987 a thunderstorm in the French Alps, lasting all evening, caused a major disaster. At about midnight a flood wave took some 200 tourists in a camp-site at Grand Bornand near Annecy by surprise and about fifty people lost their lives. The possibility of flash floods, particularly in mountainous regions needs to be considered before granting permission for such developments.

Floodproofing

This is a means of protecting individual structures from the effects of flooding. FEMA distinguishes five basic approaches to floodproofing:

- Relocation - moving away from the flood-prone area.
- Elevation - raising the building above the flood level, either on piles or on a mound.
- Flood walls - concrete or steel walls to keep the flood out.
- Dry floodproofing - making the building watertight.
- Wet floodproofing - allowing the basement and ground floor to flood while keeping the habitable portion of the building above flood level.

Floodproofing is useful for buildings that are on the riverside of a dyke or for existing buildings in areas where new flood plain land-use regulations would prohibit further development. Relocation may seem a drastic solution, but does ensure safety from future flooding. New buildings in the flood plain can readily be built above flood level, but it is unlikely to be possible to raise existing buildings. When buildings are raised on piles the piles must be designed to withstand impact with floating debris and the pile foundations need to be protected from

erosion. Properly designed, the piles can be a feature of the architecture of the building. This was the case of an office block erected on the flood plain of the River Thames at Reading, United Kingdom, in the mid-1970s. Raising the building on piles gave it a distinctive look which reflected to the credit of the company that owned it. The space under the building could also be used for car parking. In Bangladesh, flood refuges are built on raised mounds to provide a safe haven for villagers during floods. Each is equipped with a tube well and sanitation and in normal times the refuge is used for community purposes, such as a school, mosque or meeting-place. This last point is important, if the refuge has an everyday use the community will be able to afford it and it will be maintained in good condition and ready for emergency use.

Floodproofing has to be extended to the infrastructure. Roads and bridges crossing the flood plain need to be raised above flood level to maintain communications. They should preferably be raised on piles as an embankment would impede the flood flow. Water treatment installations must be protected from pollution by flood waters. It is all too common for the municipal water supply to be interrupted during a flood because of contamination. In these circumstances, the population would normally be advised to boil all water before use, but given the general dislocation, it may be very difficult for this advice to be carried out. Non-return valves should be used in sewers to prevent sewage being carried back into homes and other buildings. The need to keep telephone and electricity systems above flood level was mentioned above. Oil tanks need to be protected from floods. Oil spilling from storage tanks is a serious source of pollution in many floods. This does not only apply to the large storage tanks of the oil companies; the large number of small domestic fuel oil tanks, in varying states of repair, can spill significant quantities of oil during a flood.

Flood walls, of concrete, masonry or steel, are a simple method of waterproofing an existing building more cheaply than by building an earth dyke around it. A door or gate in the wall, capable of being sealed in emergency, can provide access to the building in normal times. Temporary flood walls can be erected to contain short extreme flood peaks. They are more effective than sandbag walls, but more expensive and also cannot be raised if the flood is higher than expected. They were used to protect Cologne and other riverside towns during the Rhine floods in 1993 and 1995.

Dry floodproofing requires making the building completely watertight up to flood level. Windows and doors are easily sealed, but there are many other ways that water can enter a building. For example the ventilation holes for underfloor spaces, required by building regulations, will allow the entry of water that can then rise up through the floorboards. If a building is watertight then it must be designed to withstand the stresses imposed by the water. The building must be strong enough to resist the pressure of the flood waters on walls and floors. If the building is not heavy enough it could also start to float away. These effects are even greater if the building has a basement, which being deeper under the water encounters higher pressures. Floodproofed buildings must be able to withstand the drag forces due to the flow of water around the building and there is a danger of scour undermining the building. Given the difficulties of making an existing building really watertight and flood resistant, a flood wall around the building may be a simpler alternative, but any basement would still have to be able to withstand water pressure. Wet floodproofing means that the building is designed to be flooded in the basement and ground floor (or higher depending on the flood level). It requires that the basement and ground floor are able be evacuated

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Floods in Cologne, December 1993.
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